# RSE Compliance Evaluation – Results Report

| | | | |
|---|---|---|---|
| **RSE Vendor Name** | | **RSE Serial Number** | |
| **Vendor Support Staff** | | **Tester Names** | |
| **Test Dates** | | **Test Location** | |
| **Compliance Status** | Complaint / Non-Compliant | | |

This document outlines the procedures for the compliance evaluation conducted by SAIC for the next generation of roadside devices. Listed below are the various test cases constructed from the requirements document, and the test results and associated comments are listed on the following pages. Screen shots will be captured to document non-compliance.

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| Test Case No. | Test Case Name | Result |
|---|---|---|
| | IP Data Gateway Functionality | |
| IP_WSA-01 | WSA Format and Rate | |
| IP_SWSA-01 | WSA Format | |
| IP_GAT-01 | IPv6 Gateway Functionality | |
| | Log File Connection | |
| SS_LFG-01 | RSE System Status Log File Generation | |
| SS_LLFM-01 | RSE System Status Local Log File Management | |
| SS_RLFM-01 | RSE System Status Remote Log File Management | |
| SS_LFG-01 | RSE Communication Message Log File Generation | |
| CM_LLFM-01 | RSE Communication Message Local Log File Management | |
| CM_RLFM-01 | RSE Communication Message Remote Log File Management | |
| | Heartbeat, Immediate Forward/Store & Repeat | |
| SYSMGNT-HM-GEN | Heartbeat Message Generation and Suspension | |
| SYSMGNT-HM-STATCD | Heartbeat Message Generation and Suspension | |
| WSMP-IF | WAVE Short Message Protocol Immediate Forward | |
| WSMP-S&R-01 | WSMP Store and Repeat | |
| | Multiple Radio Sets | |
| MR-RS WSA Ops | Multiple DSRC Radio-Set WAVE Service Announcement Operation | |
| M-RS SCH Ops | Multiple DSRC Radio-Set Service Channel Operation | |
| M-RS CCH Ops | Multiple DSRC Radio-Set Control Channel Operation | |

# *1.0 Sample WAVE Service Advertisement – Model Deployment*

## 1.1 Context[1]

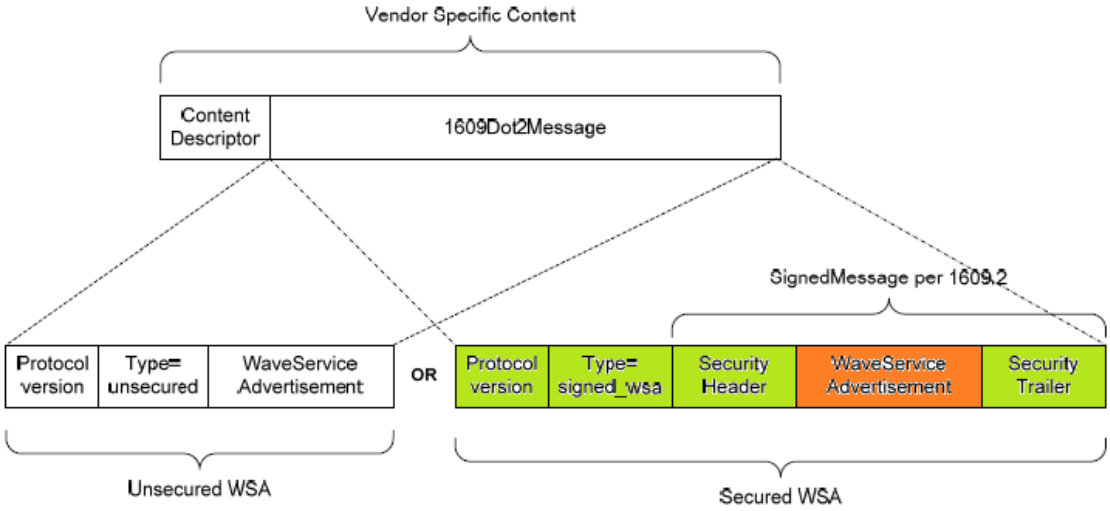


**Figure 16—WSA format**

## 1.2 Bytes (Hex):

```
04 04 01 14 06 0f 11 8d e1 0c c5 38 5a 62 08 fc 66 ff ff ff ff 07 05 55 53 44 4f 54 01
23 1f 01 08 04 53 43 4d 53 09 10 20 01 18 90 11 0e a7 77 00 00 00 00 00 00 00 03 0a 02
3e dc 02 11 b6 00 0c 14 15 01 01 03 07 08 20 01 04 70 e0 fb 99 99 00 00 00 00 00 00 00
00 40 20 01 04 70 e0 fb 99 99 00 00 00 00 00 00 00 01 20 01 04 70 e0 fb 99 99 00 00 00
00 00 00 00 01
```

## 1.3 Breakdown per 1609.3

Note that the lengths provided for the fields in the table are for the example values that are populated and many of the fields are variable length. Values in **green** are taken from the configuration file of a specific installation.

| Field name | | | Length (octets) | Value (hex) | Description |
|---|---|---|---|---|---|
| WSA Header | *WAVE Version/Change Count* | | 1 | 04 | WAVE Version = 1 (6 bits)<br>Change Count = 0 (2 bits)<br>0x04 = 0b(000001)(00) |
| | | *Transmit Power Used* | 3 | 04<br>01<br>14 | WAVE Element ID = 4<br>Length = 1<br>20 dBm |

[1] IEEE Standard for Wireless Access in Vehicular Environments (WAVE)—Networking Services, IEEE Std 1609.3™-2010, 30 December 2010

| | | | | | |
|---|---|---|---|---|---|
| | WSA Header extension fields *(Optional and for information purposes only)* | *3DLocationAndConfidence* | 17 | 06<br>0f<br>11 8d e1 0c<br>c5 38 5a 62<br><br>08 fc<br><br>66<br><br><br>ff ff ff ff | WAVE Element ID = 6<br>Length = 15<br>latitude (4 octets): +29.451086 °<br>longitude (4 octets): -98.616259 °<br>elevation (2 octets): +230m position<br>confidence (4 bits):<br>6 = 10 m<br>elevation confidence (4 bits):<br>6 = 10 m<br>positional accuracy (4 octets):<br>'unavailable'<br><br>*NOTE: 3DLocationAndConfidence values should be populated from GPS receiver on RSE.* |
| | | *Advertiser Identifier* | 7 | 07<br>05<br>**55 53 44 4f**<br>**54** | WAVE Element ID = 7<br>Length = 5<br>ASCII content: '**USDOT**' |

| | | | | | |
|---|---|---|---|---|---|
| Service Info | *Service Info WAVE element ID* | | 1 | 01 | per Annex E |
| | *Provider Service Identifier* | | 1 | **23** | PSID: **0x23** |
| | *ServicePriority* | | 1 | **1f** | priority: **31** |
| | *Channel Index* | | 1 | **01** | **1**st set |
| | Service Info extension fields | *Provider Service Context* | 6 | 08<br>04<br>**53 43 4d 53** | WAVE Element ID = 8<br>Length = 4<br>ASCII content: '**SCMS**' |
| | | *IPv6 Address* | 18 | 09<br>10<br>**20 01 18 90**<br>**11 0e a7 77**<br>**00 00 00 00**<br>**00 00 00 03** | WAVE Element ID = 9<br>Length = 16<br>**2001:1890:110e:a777::3** |
| | | *Service Port* | 4 | 0a<br>02<br>**3e dc** | WAVE Element ID = 10<br>Length=2<br>port=**16092**<br><br>*NOTE: The decision has not been made if 16092 will be the SCMS port* |
| Channel Info | *Channel Info WAVE element ID* | | 1 | 02 | per Annex E |
| | *Operating Class* | | 1 | 11 | Operating Class: 17 |
| | *Channel Number* | | 1 | **b6** | channel: **182** |
| | *Adaptable* | | 1 | 00 | 0: fixed |
| | *DataRate* | | 1 | 0c | Data Rate: 6 Mb/s |
| | *Transmit Power Level* | | 1 | 14 | 20 dBm |

| | | | | | |
|---|---|---|---|---|---|
| | Channel Info extension fields | *Channel access* | 3 | 15<br>01<br>01 | WAVE Element ID = 21<br>Length = 1<br>1: alternating access |

| | | | | |
|---|---|---|---|---|
| WAVE Routing Advertisement | *WRA WAVE element ID* | 1 | 03 | per Annex F |
| | *Router Lifetime* | 2 | 07 08 | 1800 s |
| | *IpPrefix* | 16 | 20 01 04 70<br>e0 fb 99 99<br>00 00 00 00<br>00 00 00 00 | **2001:0470:e0fb:9999::0000** |
| | *Prefix Length* | 1 | 40 | 64 bits |
| | *Default Gateway* | 16 | 20 01 04 70<br>e0 fb 99 99<br>00 00 00 00<br>00 00 00 01 | **2001:0470:e0fb:9999:: 1**<br><br>*NOTE: This is the RSE IPv6 address.* |
| | *Primary DNS* | 16 | 20 01 04 70<br>e0 fb 99 99<br>00 00 00 00<br>00 00 00 01 | **2001:0470:e0fb:9999:: 1** |

## *2.0 DSRC Channel Assignments*

| Applications | SAE J2735 message | DSRC Channel | Advertised in WSA | Data protocol & 1609.2 Security |
|---|---|---|---|---|
| EEBL | MSG_BasicSafetyMessage<br>(Part I, Part II) | 172 | No | Signed WSM |
| FCW | MSG_BasicSafetyMessage<br>(Part I, Part II) | 172 | No | Signed WSM |
| CICAS-V | MSG_SignalPhaseAndTiming<br>MSG_MapData<br>Position Correction TBD MSG | 172 only | No | Signed WSM |
| Curved Speed | MSG_TravelerInformationMessage | 178 only | No | Signed WSM |
| Access to Security Credential Management | None | Service channel (e.g. 174, 176, 180, 182, 184) | Yes | IPv6-based protocol |

## *3.0 PSID Assignments*

| Common Message Name | PSID | IEEE message name | Note |
|---|---|---|---|
| Basic Safety Message (BSM) | 0x20 | Vehicle to Vehicle Safety and Awareness | Only one value for BSM's will be used since all devices will need to meet the same requirements. |
| Traveler Information Message (TIM) | 0x8003 | traffic-traveller-information | Only one TIM message will be used – a signage message to support curve speed warning applications. |
| Signal Phase and Timing (SpAT) | 0xBFE0 | Intersection Safety and Awareness | **Test value for SPaT DSRCmsgID = XXX for Model Deployment** |
| Signal Phase and Timing (SpAT) | 0x8002 | Intersection Safety and Awareness | Test value for SPaT DSRCmsgID = 13 for Telegraph Road |
| MAP message (aka GID) | 0xBFF0 | Intersection Safety and Awareness | **Test value for MAP DSRCmsgID = XXX for Model Deployment** |
| MAP message (aka GID) | 0x8002 | Intersection Safety and Awareness | Test value for MAP DSRCmsgID = 7 for Telegraph Road |
| Security Credential Management | 0x23 | WAVE Security Management | |
| General IP Data Exchange | 0xBFE1 | | Test value for applications other than security credential management |

## *4.0 Test Cases*

**Tools required by the test conductor to perform the tests:**

- Windows PC:
- Windows xp/7
- WinSCP
- Putty (Win SSH)
- Linux PC
- Ssh client
- Scp client
- DSRC Protocol Analyzer
- USB storage device
- Backhaul server / Test SCMS server
- Backhaul SCP server / Secure File Transfer protocol support
- Network switch with IPv6 support

### 4.1 IP Data Gateway Functionality

The RSE will serve as an IPv6 gateway between vehicle-based devices and the security credential management system (SCMS). A WAVE Service Announcement (WSA) configured with PSID 0x23 and the appropriate service channel and routing information will advertise the service to passing vehicles.

#### *4.1.1 Test Case IP-WSA-01*

##### *4.1.1.1 GENERAL TEST DESCRIPTION*

This Test Case confirms that the RSE sends a properly formatted Wave Service Announcement (WSA), based on the USDOT provided WSA Template.

| | |
|---|---|
| **Test Case #** | **IP-WSA-01** |
| **Test Case** | **WSA Format and Rate** |
| **Reference** | *T-10001-T2-05_RSE_Device_Design_Specification_v30* |
| **Objective** | Confirms the RSE under test sends a properly formatted and populated Wave Service Announcement (WSA) |
| **Requirements verified** | • IEEE 1609.3 RSE requirements<br>• IEEE 1609.4 RSE requirements<br>• IEEE 802.11p RSE requirements |
| **Brief Description** | The RSE under test is powered on and begins transmitting WSAs per the RSE specification. A DSRC Protocol Analyzer collects and stores all received packets from the RSE. The number of captured WSAs is used to confirm transmission rate and a sample of WSAs will be decoded to confirm format and content. |

| | |
|---|---|
| **Test Case #** | **IP-WSA-01** |
| **Test Case** | **WSA Format and Rate** |
| **Entrance Criteria** | • Production grade RSE hardware and software is available for testing |
| **Configuration** | RSE is configured to send un-signed WSAs. |
| **Exit Criteria** | RSE sends a WSA based on the USDOT provided WSA template |
| **Data Outputs** | Test Conductor Data Sheet and output of DSRC WSA analyzer |

*4.1.1.2 EVALUATION PROCEDURES*

The RSE under test is powered on and begins transmitting WSAs per the RSE specification. A DSRC Protocol Analyzer collects and stores all received packets from the RSE. The number of captured WSAs is used to confirm transmission rate and a sample of WSAs will be decoded to confirm format and content.

***Steps to Turn the RSE into the ON Position with proper GPS signal:***

| Steps | Procedure | Expected Result | Actual Result | Comments |
|---|---|---|---|---|
| 1 | Based on specific RSE / RSU vendor documentation, the units will be connected to a power source | | | |
| 2 | All proper communication wiring provided by the RSE/RSU vendor will be connected to the devices | | | |
| 3 | Test Conductor will ensure that a GPS active antenna with a clear view of the sky is connected to the RSE/RSU | | | |
| 4 | Ethernet transmit and receive link lights will be verified on the proper designated RSE port and the RSU port. | | | |
| 5 | Per the specification document equipment functionality and operational status will be confirmed via the status LED indicator light on the | | | |

| | | | | |
|---|---|---|---|---|
| | equipment. | | | |

***Steps to activate the DSRC protocol analyzer:***

| Steps | Procedure | Expected Result | Actual Result | Comments |
|---|---|---|---|---|
| 1 | Boot the portable DSRC protocol analyzer | | | |
| 2 | Open the DSRC protocol analyzer application | | | |
| 3 | Set DSRC protocol analyzer to channel 178 | | | |

***Steps to capture data from the RSE/RSU device under test :***

| Steps | Procedure | Expected Result | Actual Result | Comments |
|---|---|---|---|---|
| 4 | Start a capture session on the protocol analyzer | | | |
| 5 | Capture data for at the minimum time interval of 5 minutes | | | |
| 6 | Stop the capture session at the end of the 5 minutes time interval | | | |
| 7 | Save the captured data in ".pcap" format in a created specific vendor "name" directory | | | |
| 8 | The captured file name should consist of:<br>- Vendor Name<br>- Test Case<br>- Date | | | |

***Steps to Analyze captured data packets :***

Transmit Rate

| Steps | Procedure | Expected Result | Actual Result | Comments |
|---|---|---|---|---|
| 9 | Determine number of packets captured during the time interval | Default: 10Hz | | |
| 10 | Using a calculator divide the number of total packets by the time interval to determine the number of | | | |

| | | | | |
|---|---|---|---|---|
| | packets transmitted per second | | | |
| 11 | Record the number of packets transmitted per second in the datasheet | | | |
| 12 | Number of packets per second should be compliant with the specifications for 10 Hz | 10Hz expected | | |

WSA Format

| Steps | Procedure | Expected Result | Actual Result | Comments |
|---|---|---|---|---|
| 13 | Three random packets will be selected from the captured .pcap file | | | |
| 14 | Packet numbers selected for analysis will be recorded in the datasheet | | | |
| 15 | Each of the three packets will be opened with the DSRC protocol analyzer for detail analysis to confirm the WSA format per the USDOT provided WSA template | | | |
| 16 | Format exceptions will be recorded in the datasheet | | | |
| 17 | A packet that is fully compliant with the USDOT provided WSA template will be recorded in the datasheet | | | |

### *4.1.2 Test Case IP-SWSA-01*

#### *4.1.2.1 GENERAL TEST DESCRIPTION*

This Test Case confirms that the RSE sends a properly formatted IEEE 1609.2 signed Wave Service Announcement (WSA), with a properly populated Wave Routing Advertisement (WRA) based on the USDOT provided WSA Template.

| | |
|---|---|
| **Test Case #** | **IP-SWSA-01** |
| **Test Case** | **WSA Format** |

| | |
|---|---|
| **Test Case #** | **IP-SWSA-01** |
| **Test Case** | **WSA Format** |
| **Reference** | *T-10001-T2-05_RSE_Device_Design_Specification_v30* |
| **Objective** | Confirms the RSE under test sends a properly formatted Wave Service Announcement (WSA) signed with a 1609.2 Certificate |
| **Requirements verified** | • IEEE 1609.2 requirements<br>• IEEE 1609.3 requirements<br>• IEEE 1609.4 RSE requirements<br>• IEEE 802.11p RSE requirements |
| **Brief Description** | The RSE under test is powered on and begins transmitting signed WSAs per the RSE specification. A DSRC Protocol Analyzer collects and stores all received packets from the RSE. The number of captured WSAs is used to confirm transmission rate and a sample of WSAs will be decoded to confirm the 1609.2 signature, format, and content. |
| **Entrance Criteria** | • Production grade RSE hardware and software is available for testing<br>• RSEs are pre-loaded with 1609.2 certificates |
| **Configuration** | RSE is configured for normal operation |
| **Exit Criteria** | RSE sends 1609.2 signed WSAs at the specified rate and formatted based on the USDOT WSA template |
| **Data Outputs** | Test Conductor Data Sheet and output of DSRC WSA analyzer |

*4.1.2.2 EVALUATION PROCEDURES*

The RSE under test is powered on and begins transmitting WSAs per the RSE specification. A DSRC Protocol Analyzer collects and stores all received packets from the RSE. The number of captured WSAs is used to confirm transmission rate and a sample of WSAs will be decoded to confirm format and content.

***Steps to Turn the RSE into ON Position with proper GPS signal:***

| Steps | Procedure | Expected Result | Actual Result | Comments |
|---|---|---|---|---|
| 1 | Based on specific RSE/RSU vendor documentation, the units will be connected to a power source. | | | |
| 2 | All proper communication wiring provided by the RSE/RSU vendor will be connected to the devices. | | | |
| 3 | Test conductor will ensure that a GPS active antenna with a clear view of the sky | | | |

| | | | | |
|---|---|---|---|---|
| | is connected to the RSE/RSU. | | | |
| 4 | Ethernet transmit and receive link lights will be verified on the proper designated RSE port and the RSU port. | | | |
| 5 | Per the specification document equipment functionality and operational status will be confirmed via the status LED indicator light on the equipment. | | | |

***Steps to activate the DSRC protocol analyzer:***

| Steps | Procedure | Expected Result | Actual Result | Comments |
|---|---|---|---|---|
| 1 | Boot the portable DSRC protocol analyzer | | | |
| 2 | Open the DSRC protocol analyzer application. | | | |
| 3 | Set DSRC protocol analyzer to channel 178. | | | |

***Steps to capture data from the RSE/RSU device under test:***

| Steps | Procedure | Expected Result | Actual Result | Comments |
|---|---|---|---|---|
| 4 | Start a capture session on the protocol analyzer | | | |
| 5 | Capture data for a minimum time interval of 5 minutes | | | |
| 6 | Stop the capture session at the end of the 5 minutes time interval | | | |

| | | | | |
|---|---|---|---|---|
| 7 | Save the captured data in ".pcap" format in a created specific vendor "name" directory. | | | |
| 8 | The captured file name should consist of:<br>- Vendor Name<br>- Test Case<br>- Date<br>- Time | | | |

***Steps to capture data from the RSE/RSU device under test:***

Transmit Rate

| Steps | Procedure | Expected Result | Actual Result | Comments |
|---|---|---|---|---|
| 9 | Determine number of packets captured during the time interval | | | |
| 10 | Using a calculator divide the number of total packets by the time interval to determine the number of packets transmitted per second. | | | |
| 11 | Record the number of packets transmitted per second in the datasheet. | | | |
| 12 | Number of packets per second should be compliant with the RSE specifications to 10Hz | | | |

Signed WSA Format:

| Steps | Procedure | Expected Result | Actual Result | Comments |
|---|---|---|---|---|
| 13 | Three random packets will be selected from the captured .pcap file | | | |
| 14 | Packet numbers selected for analysis will be recorded in the datasheet | | | |
| 15 | Each of the three packets will be decoded with the DSRC protocol analyzer for | | | |

| | | | | |
|---|---|---|---|---|
| | detail analysis to confirm the WSA format per the USDOT provided WSA template | | | |
| 16 | Format exceptions will be recorded in the datasheet | | | |
| 17 | Each decoded WSA packet will be recorded in the datasheet | | | |

### *4.1.3 Test Case IP-GAT-01*

#### *4.1.3.1 GENERAL TEST DESCRIPTION*

This Test Case evaluates the RSEs ability to act as an IPv6 Gateway. This functionality is required to support the Security Credential Management of certain types of vehicle-based devices.

| | |
|---|---|
| **Test Case #** | **IP-GAT-01** |
| **Test Case** | **IPv6 Gateway functionality** |
| **Reference** | *T-10001-T2-05_RSE_Device_Design_Specification_v30* |
| **Objective** | Confirm a vehicle-based device can connect to a network server through an RSE over an IPv6 network. |
| **Requirements verified** | • SRD-USDOTRSE-003-ReqDRS044v001<br>• SRD-USDOTRSE-003-ReqINT003v001 |
| **Brief Description** | A vehicle-based device (VBD) that supports an IPv6 connection over DSRC is brought within communication range of the RSE under Test. Upon receiving a WSA from the RSE, the VBD configures its DSRC radio to connect to the back office sever through the RSE. |
| **Entrance Criteria** | • Production grade RSE hardware and software is available for testing<br>• RSEs are pre-loaded with 1609.2 certificates<br>• Vehicle-based capable of connecting to an IPv6 network is available for testing.<br>• Vehicle-based device is pre-loaded with 1609.2 certificates |
| **Configuration** | The RSE is configured for normal operation. |
| **Exit Criteria** | VBD is able to connect to a back office server over the IPv6 network advertised in the WSA |
| **Data Outputs** | Test Conductor Data Sheet |

#### *4.1.3.2 EVALUATION PROCEDURES*

Management is brought within communication range of the RSE under Test. Upon receiving a WSA from the RSE, the VBD configures its DSRC radio to connect to the back office sever through the RSE.

***Steps to turn the RSE into ON position with proper GPS signal :***

| Steps | Procedure | Expected Result | Actual Result | Comments |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 1 | Based on specific RSE / RSU vendor documentation, the units will be connected to a power source | | | |
| 2 | All proper communication wiring provided by the RSE/RSU vendor will be connected to the devices | | | |
| 3 | Test conductor will ensure that a GPS active antenna with a clear view of the sky is connected to the RSE/RSU | | | |
| 4 | Ethernet transmit and receive link lights will be verified on the proper designated RSE port and the RSU port | | | |
| 5 | Per the specification document equipment functionality and operational status will be confirmed via the status LED indicator light on the equipment | | | |

***Steps to verify IPv6 connectivity from the RSE/RSU to the backhaul server (test SCMS server):***

| Steps | Procedure | Expected Result | Actual Result | Comments |
|---|---|---|---|---|
| 6 | Test conductor will access vendor device over a local Ethernet connection from a PC running Windows/Linux with web browsing capability and ssh client for accessing the RSE/RSU | | | |
| 7 | Test conductor will follow vendor specific instructions to access device and confirm proper IPv6 configuration | | | |
| 8 | Test conductor will verify proper IPv6 address is assigned to the physical Ethernet port and verify IPv6 address / prefix | | | |

| | | | | |
|---|---|---|---|---|
| | assigned to the DSRC radio interface port | | | |
| 9 | Test conductor will perform a ping6 from the vendor device to the backhaul test server with the IPv6 address of "2001:1890:110e:a777::3" | | | |
| 10 | If ping6 is successful from the vendor device to the backhaul test server, test conductor will proceed to the Vehicle Based Device (VBD) | | | |

***Steps to turn the VBD into ON position with proper GPS signal:***

| Steps | Procedure | Expected Result | Actual Result | Comments |
|---|---|---|---|---|
| 11 | Place the VBD device on the test bench within the DSRC range of the RSE/RSU under evaluation | | | |
| 12 | Based on specific VBD vendor documentation, the units will be connected to a power source | | | |
| 13 | All proper communication wiring provided by the vendor will be connected to the devices | | | |
| 14 | Test conductor will ensure that a GPS active antenna with a clear view of the sky is connected to the VBD device | | | |
| 15 | Ethernet transmit and receive link lights will be verified on the proper designated port for proper IPv4 communication | | | |
| 16 | Per the specification document equipment functionality and operational status will be confirmed via the status LED indicator light on the | | | |

| | | | | |
|---|---|---|---|---|
| | equipment | | | |

***Steps to verify IPv6 connectivity from the VBD to the backhaul server (test SCMS server):***

| Steps | Procedure | Expected Result | Actual Result | Comments |
|---|---|---|---|---|
| 17 | Test conductor will access vendor device over a local Ethernet connection from a PC running Windows/Linux via ssh client for accessing the VBD | | | |
| 18 | Test conductor will follow vendor specific instructions to access device and confirm operation status | | | |
| 19 | Test conductor will execute a command at the shell prompt to verify network interface IP assignments and MAC-addresses of all the network interfaces | | | |
| 20 | Test conductor will execute a command at the shell prompt to verify the DSRC port IPv6 address assignment | | | |
| 21 | The DSRC IPv6 address should be in the same prefix as the RSE/RSU device DSRC interface | | | |
| 22 | Test conductor will execute a routing command at the shell prompt to verify proper WRA instructions were followed and the default route (Gateway) is set as the RSE/RSU DSRC interface IPv6 address. These IP addresses are provided in the WSA/WRA | | | |
| 23 | Test conductor will perform a ping6 from the vendor device to the RSE/RSU test server with the IPv6 address of "2001:470:e0fb:XXXX::1" | | | |

| | | | | |
|---|---|---|---|---|
| | (this is the RSE/RSU DSRC interface IPv6 address) | | | |
| 24 | Screen captures of the VBD ping6 to the RSE\RSU test will be recorded in the data sheet | | | |
| 25 | If step twenty three (23) is successful move to the next step: | | | |
| 26 | Test conductor will perform a ping6 from the vendor device to the backhaul test server with the IPv6 address of "2001:1890:110e:a777::3" | | | |
| 27 | Test conductor may use a DSRC protocol analyzer to listen for over the air DSRC communication packets on the service channels to observe ping6 packets between the RSE/RSU and the VBD device | | | |

## 4.2 Log File Connection

The RSE will collect system status and communication interface log files and periodically transfer them to a back office collection service using the available backhaul connection. The RSE will also send Health Monitoring messages to a back office service such that the status of the device can be monitored remotely.

### *4.2.1 Test Case SS_LFG-01*

#### *4.2.1.1 GENERAL TEST DESCRIPTION*

This Test Case confirms RSEs generate system status log files.

| **Test Case #** | **SS_LFG-01** |
|---|---|
| **Test Case** | **RSE System Status log File generation** |
| **Reference** | *T-10001-T2-05_RSE_Device_Design_Specification_v30* |
| **Objective** | Confirm the RSE under test generates System Status Log Files according to the listed requirements |
| **Requirements** | • SRD-USDOTRSE-002-ReqSSL002v001 |

| | |
|---|---|
| **Test Case #** | **SS_LFG-01** |
| **Test Case** | **RSE System Status log File generation** |
| **verified** | • SRD-USDOTRSE-002-ReqSSL009v001<br>• SRD-USDOTRSE-002-ReqSSL010v001<br>• SRD-USDOTRSE-002-ReqSSL012v001<br>• SRD-USDOTRSE-002-ReqSSL013v001<br>• SRD-USDOTRSE-002-ReqSSL014v001<br>• SRD-USDOTRSE-002-ReqSSL015v001<br>• SRD-USDOTRSE-002-ReqSSL016v001<br>• SRD-USDOTRSE-002-ReqSSL006v001<br>• SRD-USDOTRSE-002-ReqSSL007v001<br>• SRD-USDOTRSE-002-ReqSSL018v001 |
| **Brief Description** | After the RSE has been in the "run" mode for a specified amount of time, the System Status Log Files will be evaluated for conformance to the listed requirements |
| **Entrance Criteria** | • Production grade RSE hardware and software is available for testing |
| **Configuration** | RSE is configured for normal operation |
| **Exit Criteria** | RSE generates System Status Log Files according to listed requirements. |
| **Data Outputs** | Test Conductor Data Sheet and device System Status log files |

*4.2.1.2 EVALUATION PROCEDURES*

After the RSE has been in the "run" mode for a specified amount of time, the System Status Log (SSL) Files will be evaluated for conformance to the listed requirements.

***Steps to verify SSL Log File naming convention and format :***

| Steps | Procedure | Expected Result | Actual Result | Comments |
|---|---|---|---|---|
| 1 | Test conductor will access vendor device over a local Ethernet connection from a PC running Windows/Linux with web browsing capability and ssh client for accessing the RSE/RSU | | | |
| 2 | Test conductor will establish a connection to the vendor RSE/RSU in operation state | | | |
| 3 | Test conductor will navigate to the SSL logs | | | |

| | | | | |
|---|---|---|---|---|
| | directory per direction in the vendor documentation | | | |
| 4 | Test conductor will issue system commands to list the SSL log files within the SSL logs directory, displayed on the screen | | | |
| 5 | All files listed will be verified for naming convention in conformance to the requirements listed in this test case | | | |
| 6 | Test conductor will open several unique SSL log files to verify format specific to the vendor, additionally verify message format and time/date stamps within the log files | | | |
| 7 | Test conductor will record a snap shot of a sample log file on the screen | | | |

### *4.2.2 Test Case SS_LLFM-01*

#### *4.2.2.1 GENERAL TEST DESCRIPTION*

This Test Case confirms local management of the RSE system status log files.

| **Test Case #** | **SS_LLFM-01** |
|---|---|
| **Test Case** | **RSEs System Status local log file management** |
| **Reference** | *T-10001-T2-05_RSE_Device_Design_Specification_v30* |
| **Objective** | Confirm the RSE under test provides local file management of the System Status Log Files according to the listed requirements |
| **Requirements verified** | • SRD-USDOTRSE-002-ReqSSL012v001<br>• SRD-USDOTRSE-002-ReqSSL013v001<br>• SRD-USDOTRSE-002-ReqSSL015v001<br>• SRD-USDOTRSE-002-ReqSSL016v001<br>• SRD-USDOTRSE-002-ReqSSL006v001<br>• SRD-USDOTRSE-002-ReqSSL017v001<br>• SRD-USDOTRSE-002-ReqSSL019v001 |
| **Brief Description** | After the RSE has been in the "run" mode for a specified amount of time, the Test Conductor will log on to the RSE from one if its local interfaces. The System Status Log Files will be manipulated according to the listed requirements |

| Test Case # | SS_LLFM-01 |
|---|---|
| Test Case | **RSEs System Status local log file management** |
| Entrance Criteria | • Production grade RSE hardware and software is available for testing |
| Configuration | RSE is configured for normal operation |
| Exit Criteria | RSE System Status Log Files can be locally managed according to listed requirements. |
| Data Outputs | Test Conductor Data Sheet and device System Status log files |

*4.2.2.2 EVALUATION PROCEDURES*

After the RSE has been in the "run" mode for a specified amount of time, the Test Conductor will log on to the RSE from one if its local interfaces. The System Status Log Files will be manipulated according to the listed requirements

***Steps to verify requirements in the SS_LFM test case :***

| Steps | Procedure | Expected Result | Actual Result | Comments |
|---|---|---|---|---|
| 1 | Test conductor will access vendor device over a local Ethernet connection from a PC running Windows/Linux with web browsing capability and ssh client for accessing the RSE/RSU | | | |
| 2 | Test conductor will establish a connection to the vendor RSE/RSU in operation state | | | |
| 3 | Test conductor will navigate to the SSL logs directory per direction in the vendor documentation | | | |
| 4 | Test conductor will issue system commands to list the SSL log files within the SSL logs directory, displayed on the screen | | | |
| 5 | Test conductor will record a snap shot of the log file on the screen | | | |

| | | | | |
|---|---|---|---|---|
| 6 | Test conductor will issue a system command to verify storage allocation for the SSL log files by doing the following command at the shell prompt “df –h” and observe or record the storage allocation to the directory structure which the logs directory resides in, the number should be greater than 250MB in conformance to the system requirements contained in this test case | | | |
| 7 | Test conductor will issue a halt system command per the instructions provided in the vendor documentation | | | |
| 8 | Test conductor will issue a delete command as an authorized system user to delete one of the SSL log files | | | |
| 9 | Test conductor will issue a run system command per the instructions provided in the vendor documentation | | | |
| 10 | Test conductor will issue a halt system command per the instructions provided in the vendor documentation and monitor the logs directory for log file operation changes. | | | |
| 11 | Test conductor will issue a run command to bring the system back to operation state and monitor the directory along with reading some of the log files for registering current system status. | | | |
| 12 | Test conductor will take another snapshot of the login screen with the files list to ensure new SSL log files were created by the | | | |

| | | | | |
|---|---|---|---|---|
| | system post run command | | | |
| 13 | System log files will be observed by the test conductor for system messages and disconnects and reconnects of input/output devices such as GPS antennas to observe proper system messages are logged by the system of current device state | | | |
| 14 | Test conductor will open a second terminal window to the vendor device | | | |
| 15 | Test conductor will have two login sessions side-by-side on the screen to test purging capability of SSL files and storage management | | | |
| 16 | Test conductor will issue a command to write a zero file within the SSL logs directory to fill the storage space. The command to write a zero full as follows [shell_prompt#: dd if=/dev/zero of=/directory_Path_to_logs _xxx/file_name_date_time_ sequence.xxx bs=1Mb] | | | |
| 17 | Test conductor will observe on the second screen by continually listing the files within the directory to confirm SSL files being purged from oldest to newly created order. The command to observe directory and storage space as follows, [df –h (storage space)], [ls –ah (list files)] | | | |
| 18 | Test conductor will delete the large zero file created for this test case in the logs directory | | | |

### *4.2.3 Test Case SS_RLFM-01*

#### *4.2.3.1 GENERAL TEST DESCRIPTION*

This Test Case confirms local management of the RSE system status log files.

| | |
|---|---|
| **Test Case #** | **SS_RLFM-01** |
| **Test Case** | **RSEs System Status remote log file management** |
| **Reference** | *T-10001-T2-05_RSE_Device_Design_Specification_v30* |
| **Objective** | Confirm the RSE under test provides remote file management of the System Status Log Files according to the listed requirements |
| **Requirements verified** | • SRD-USDOTRSE-002-ReqSSL007v001<br>• SRD-USDOTRSE-002-ReqSSL019v001 |
| **Brief Description** | After the RSE has been in the "run" mode for a specified amount of time, the Test Conductor will log on to the RSE from a remote server. The System Status Log Files will be manipulated according to the listed requirements |
| **Entrance Criteria** | • Production grade RSE hardware and software is available for testing |
| **Configuration** | RSE is configured for normal operation |
| **Exit Criteria** | RSE System Status Log Files can be remotely managed according to listed requirements. |
| **Data Outputs** | Test Conductor Data Sheet and device System Status log files |

#### *4.2.3.2 EVALUATION PROCEDURES*

After the RSE has been in the "run" mode for a specified amount of time, the Test Conductor will log on to the RSE from a remote server. The System Status Log Files will be manipulated according to the listed requirements

***Steps to verify requirements in the SS_RLFM test case:***

| Steps | Procedure | Expected Result | Actual Result | Comments |
|---|---|---|---|---|
| 1 | Test conductor will access vendor device over a local Ethernet connection from a PC running Windows/Linux with web browsing capability and ssh client for accessing the RSE/RSU | | | |
| 2 | Test conductor will ensure that SCP services or a client is available on the PC used for this test case. From a Linux based pc "SCP" will | | | |

| | | | | |
|---|---|---|---|---|
| | be used at the command prompt for file transfer and management. From a Windows pc WinSCP available as a freeware will be used for SCP (Secure Copy) over ssh to transfer files from the vendor device on to the local PC | | | |
| 3 | Test conductor will establish a connection to the vendor RSE/RSU in operation state | | | |
| 4 | Test conductor will navigate to the SSL logs directory per direction in the vendor documentation | | | |
| 5 | Test conductor will issue system commands to list the SSL log files within the SSL logs directory, displayed on the screen | | | |
| 6 | Test conductor will record a snap shot of the login screen, to show the list of files on the screen in the current directory | | | |
| 7 | Test conductor will perform a ping6 from the vendor device to the backend SCP server setup by Lee Mixon with the IPv6 address of "2001:470:bc55::2" | | | |
| 8 | Screen captures of the RSE\RSU ping6 to the SCP server test will be recorded in the data sheet | | | |
| 9 | Test conductor will make a WinSCP connection if performed from a windows desktop, Test conductor will use shell prompt "scp" command if a Linux desktop is used for this test | | | |
| 10 | Test conductor will navigate if WinSCP is used to the directory of the SSL | | | |

| | | | | |
|---|---|---|---|---|
| | log files on the device | | | |
| 11 | Select all saved SSL log files from the directory and drag on to the local pc within a pre-determined directory associated with the vendor under testing | | | |
| 12 | Test conductor will confirm that all files transferred using WinSCP with scp protocol are transferred without any errors, by comparing file contents and file size on the two systems | | | |
| 13 | Screen captures indicating the files have been transferred will be recorded in the data sheet | | | |
| 14 | If a Linux based pc is used for file transfer, test conductor will do the following to transfer files | | | |
| 15 | At the shell prompt from the Linux pc, test conductor will create a directory associated with the vendor under test | | | |
| 16 | Test conductor will scp files from the vendor device over to the local directory on the Linux pc | | | |
| 17 | The command to move files from the vendor device to the linux pc as follows:<br>[shell_prompt#: scp username@vendordevice_ip_address:/directory_Path_to_logs_xxx/file_name_date_time_sequence* | | | |
| 18 | Test conductor will confirm that all files transferred using WinSCP with scp protocol are transferred without any errors, by comparingfile contents and file size on the two systems | | | |

| | | | | |
|---|---|---|---|---|
| 19 | Screen captures indicating the files have been transferred will be recorded on the data sheet | | | |
| 20 | Test Conductor will attempt remote file transfers from the vendor device to the Lee Mixon scp server with IPv6 address of "2001:470:bc55::2" | | | |
| 21 | Test conductor at the shell prompt from the vendor device will use scp to transfer saved SSL files in the SSL directory over to the Lee Mixon SCP server | | | |
| 22 | Test conductor will use the following command method for this test:<br>Shell_prompt#: scp ssl_log_files_name* vendortest@[2001:470:bc55::2]: | | | |
| 23 | Test conductor will observe file transfer from the vendor device to the Lee Mixon SCP server | | | |
| 24 | Test conductor will access the Lee Mixon SCP server from another pc to verify file transfer was successful and all files were transferred from the vendor device to the scp server without any errors | | | |
| 25 | Screen captures indicating the files have been transferred will be recorded in the data sheet | | | |
| 26 | Test conductor will delete all files from the scp server and observe an automatic transfer of files from the vendor device using scp scripts to the Lee Mixon scp server | | | |

| | | | | |
|---|---|---|---|---|
| 27 | Test conductor will halt vendor system and issue a run command to see if closed SSL files as result of "halt" / "run" commands have been transferred automatically to the Lee Mixon SCP server | | | |
| 28 | Vendor may provide the test conductor with instructions to change the transfer time schedule so it can push files on 5 minute intervals for this test | | | |
| 29 | If vendor changes time interval to 5 minutes, closed SSL log files as the result of the system "halt"/"run" should be uploaded to the remote SCP server | | | |

### *4.2.4 Test Case CM_LFG-01*

#### *4.2.4.1 GENERAL TEST DESCRIPTION*

This Test Case confirms RSEs generate system status log files.

| | |
|---|---|
| **Test Case #** | **CM_LFG-01** |
| **Test Case** | **RSE Communication Message Log File generation** |
| **Reference** | *T-10001-T2-05_RSE_Device_Design_Specification_v30* |
| **Objective** | Confirm the RSE under test generates Communication Message Log Files according to the listed requirements |
| **Requirements verified** | • SRD-USDOTRSE-002-ReqCML001v001<br>• SRD-USDOTRSE-002-ReqCML002v001<br>• SRD-USDOTRSE-002-ReqCML003v001<br>• SRD-USDOTRSE-002-ReqCML004v001<br>• SRD-USDOTRSE-002-ReqCML008v001<br>• SRD-USDOTRSE-002-ReqCML009v001<br>• SRD-USDOTRSE-002-ReqCML016v001 |
| **Brief Description** | After the RSE has been in the "run" mode for a specified amount of time, the Communication Message Log Files will be evaluated for conformance to the listed requirements |
| **Entrance Criteria** | • Production grade RSE hardware and software is available for testing |

| Test Case # | CM_LFG-01 |
|---|---|
| Test Case | RSE Communication Message Log File generation |
| Configuration | RSE is configured for normal operation |
| Exit Criteria | RSE generates Communication Message Log Files according to listed requirements. |
| Data Outputs | Test Conductor Data Sheet and device Communication Message Log Files |

*4.2.4.2 EVALUATION PROCEDURES*

After the RSE has been in the "run" mode for a specified amount of time, the Communication Message Log Files will be evaluated for conformance to the listed requirements

***Steps to verify CML Log File generation, naming convention and format:***

| Steps | Procedure | Expected Result | Actual Result | Comments |
|---|---|---|---|---|
| 1 | Test conductor will access RSE\RSU under evaluation over a local Ethernet connection from a PC running Windows/Linux with web browsing capability and ssh client for accessing the RSE/RSU | | | |
| 2 | Test conductor will establish a connection to the vendor RSE/RSU in operation state | | | |
| 3 | Test conductor will navigate to the CML (Communications Message Log) logs directory per direction in the vendor documentation | | | |
| 4 | Test conductor will issue system commands to list the CML log files within the CML logs directory, displayed on the screen | | | |
| 5 | All files listed will be verified for naming convention in conformance to the requirements listed in this test case | | | |
| 6 | All files must be saved in .pcap file format, this will be observed and | | | |

| | | | | |
|---|---|---|---|---|
| | verified by the test conductor | | | |
| 7 | Screen captures showing the CML files will be recorded in the data sheet | | | |
| 8 | Test Conductor will issue a communications interface command to verify active communication interfaces. Command (ifconfig –a \|more) | | | |
| 9 | Test conductor will verify in the CML logs directory that there are CML files associated with the communication interfaces confirmed in the previous step | | | |
| 10 | Test conductor will verify newly created CML log files and previously closed CML log files in the directory on the vendor device | | | |
| 11 | Test conductor will record a snap shot of the login screen, to show the list of files on the screen in the current directory | | | |

### *4.2.5 Test Case CM_LLFM-01*

#### *4.2.5.1 GENERAL TEST DESCRIPTION*

This Test Case confirms local management of the RSE Communication Message Log Files.

| **Test Case #** | **CM_LLFM-01** |
|---|---|
| **Test Case** | **RSE Communication Message local log file management** |
| **Reference** | *T-10001-T2-05_RSE_Device_Design_Specification_v30* |
| **Objective** | Confirm the RSE under test provides local file management of the Communication Message Log Files according to the listed requirements |
| **Requirements verified** | • SRD-USDOTRSE-002-ReqCML005v001<br>• SRD-USDOTRSE-002-ReqCML006v001<br>• SRD-USDOTRSE-002-ReqCML007v001<br>• SRD-USDOTRSE-002-ReqCML010v001 |

| | |
|---|---|
| **Test Case #** | **CM_LLFM-01** |
| **Test Case** | **RSE Communication Message local log file management** |
| | • SRD-USDOTRSE-002-ReqCML011v001<br>• SRD-USDOTRSE-002-ReqCML012v001<br>• SRD-USDOTRSE-002-ReqCML014v001<br>• SRD-USDOTRSE-002-ReqCML017v001<br>• SRD-USDOTRSE-002-ReqCML019v001<br>• SRD-USDOTRSE-002-ReqCML022v001 |
| **Brief Description** | After the RSE has been in the "run" mode for a specified amount of time, the Test Conductor will log on to the RSE from one if its local interfaces. The Communication Message Log Files will be manipulated according to the listed requirements |
| **Entrance Criteria** | • Production grade RSE hardware and software is available for testing |
| **Configuration** | RSE is configured for normal operation |
| **Exit Criteria** | RSE Communication Message Log Files can be locally managed according to listed requirements. |
| **Data Outputs** | Test Conductor Data Sheet and device Communication Message log files |

*4.2.5.2 EVALUATION PROCEDURES*

After the RSE has been in the "run" mode for a specified amount of time, the Test Conductor will log on to the RSE from one if its local interfaces. The Communication Message Log Files will be manipulated according to the listed requirements

***Steps to verify requirements in the CM_LLFM test case :***

| Steps | Procedure | Expected Result | Actual Result | Comments |
|---|---|---|---|---|
| 1 | Test conductor will access vendor device over a local Ethernet connection from a PC running Windows/Linux with web browsing capability and ssh client for accessing the RSE/RSU | | | |
| 2 | Test conductor will establish a connection to the vendor RSE/RSU in operation state | | | |
| 3 | Test conductor will navigate to the CML logs directory per direction in the vendor documentation | | | |

| | | | | |
|---|---|---|---|---|
| 4 | Test conductor will issue system commands to list the CML log files within the CML logs directory, displayed on the screen | | | |
| 5 | Test conductor will record a snap shot of the login screen, to show the list of files on the screen in the current directory | | | |
| 6 | Test conductor will issue a system command to verify storage allocation for the CML log files by doing the following command at the shell prompt “df –h” and observe or record the storage allocation to the directory structure which the logs directory resides in, the number should be equal or greater than 4GB in conformance to the system requirements contained in this test case | | | |
| 7 | Test conductor will issue a halt system command per the instructions provided in the vendor documentation | | | |
| 8 | Test conductor will issue a delete command as an authorized system user to delete one of the CML log files | | | |
| 9 | Test conductor will issue a run command per the instructions provided in the vendor documentation | | | |
| 10 | Test conductor will issue a halt system command per the instructions provided in the vendor documentation and monitor the logs directory for log file operation changes | | | |
| 11 | Test conductor will issue a run command to bring the | | | |

| | | | | |
|---|---|---|---|---|
| | system back to operation state and monitor the directory along with reading some of the log files for registering current system status | | | |
| 12 | Test conductor will take another snapshot of the login screen with the files list to ensure new CMLlog files were created by the system post run command | | | |
| 13 | Communication System log files will be observed by the test conductor for proper interface associated log files in .pcap format | | | |
| 14 | Test conductor will open a second terminal window to the vendor device | | | |
| 15 | Test conductor will have two login sessions side-by-side on the screen to test purging capability of CML files and storage management | | | |
| 16 | Test conductor will issue a command to write a zero file within the CML logs directory to fill the storage space. The command to write a zero file as follows [shell_prompt#: dd if=/dev/zero of=/directory_Path_to_logs _xxx/file_name_date_time_ sequence.xxx bs=1Mb] | | | |
| 17 | Test conductor will observe on the second screen by continually listing the files within the directory to confirm CML files being purged/expunged from oldest to newly created order. The command to observe directory and storage space as follows, [df –h (storage space)], [ls – | | | |

| | | | | |
|---|---|---|---|---|
| | ah (list files)] | | | |
| 18 | Test conductor will delete the large zero file created for this test case in the logs directory | | | |
| 19 | Test conductor will select already closed CML files and push using the vendor scp file transfer script to confirm (expunge each off-loaded CML file upon successfully completion of the system initiated off-load operation). This requirement can be verified under the next test case as well if the test conductor chooses to test with the next test case of CML log file remote management | | | |

### *4.2.6 Test Case CM_RLFM-01*

#### *4.2.6.1 GENERAL TEST DESCRIPTION*

This Test Case confirms remote management of the RSE Communication Message Log Files.

| | |
|---|---|
| **Test Case #** | **CM_RLFM-01** |
| **Test Case** | **RSE Communication Message remote log file management** |
| **Reference** | *T-10001-T2-05_RSE_Device_Design_Specification_v30* |
| **Objective** | Confirm the RSE under test provides remote management of the Communication Message Log Files according to the listed requirements |
| **Requirements verified** | • SRD-USDOTRSE-002-ReqCML013v001<br>• SRD-USDOTRSE-002-ReqCML018v001<br>• SRD-USDOTRSE-002-ReqCML019v001 |
| **Brief Description** | After the RSE has been in the "run" mode for a specified amount of time, the Test Conductor will log on to the RSE from a remote server. The Communication Message Log Files will be manipulated according to the listed requirements |
| **Entrance Criteria** | • Production grade RSE hardware and software is available for testing |
| **Configuration** | RSE is configured for normal operation |
| **Exit Criteria** | RSE Communication Message Log Files can be remotely managed according to listed requirements. |

| Test Case # | CM_RLFM-01 |
|---|---|
| Test Case | RSE Communication Message remote log file management |
| Data Outputs | Test Conductor Data Sheet and device Communication Message log files |

*4.2.6.2 EVALUATION PROCEDURES*

After the RSE has been in the "run" mode for a specified amount of time, the Test Conductor will log on to the RSE from a remote server. The Communication Message Log Files will be manipulated according to the listed requirements

***Steps to verify requirements in the CM_RLFM test case :***

| Steps | Procedure | Expected Result | Actual Result | Comments |
|---|---|---|---|---|
| 1 | Test conductor will access vendor device over a local Ethernet connection from a PC running Windows/Linux with web browsing capability and ssh client for accessing the RSE/RSU | | | |
| 2 | Test conductor will ensure that SCP services or a client is available on the PC used for this test case. From a Linux based pc "SCP" will be used at the command prompt for file transfer and management. From a Windows pc WinSCP available as a freeware will be used for SCP (Secure Copy) over ssh to transfer files from the vendor device on to the local pc | | | |
| 3 | Test conductor will establish a connection to the vendor RSE/RSU in operation state | | | |
| 4 | Test conductor will navigate to the CML logs directory per direction in the vendor documentation | | | |
| 5 | Test conductor will issue system commands to list the CML log files within | | | |

| | | | | |
|---|---|---|---|---|
| | the CML logs directory, displayed on the screen | | | |
| 6 | Test conductor will record a snap shot of the login screen displaying the directory content | | | |
| 7 | Test conductor will perform a ping6 from the vendor device to the backend SCP server setup by Lee Mixon with the IPv6 address of “2001:470:bc55::2” | | | |
| 8 | Test conductor will make a WinSCP connection if performed from a windows desktop, Test conductor will use shell prompt “scp” command if a Linux desktop is used for this test | | | |
| 9 | Test conductor will navigate if WinSCP is used to the directory of the CML log files on the device | | | |
| 10 | Select all saved/closed CML log files from the directory and drag on to the local pc within a pre determined directory associated with the vendor under testing | | | |
| 11 | Test conductor will verify that all files transferred using WinSCP with scp protocol are transferred without any errors | | | |
| 12 | If a Linux based pc is used for file transfer, test conductor will do the following to transfer files | | | |
| 13 | At the shell prompt from the Linux pc, test conductor will create a directory associated with the vendor under test | | | |
| 14 | Test conductor will scp files over from the vendor | | | |

| | | | | |
|---|---|---|---|---|
| | device over to the local directory on the Linux pc | | | |
| 15 | The command to move files from the vendor device to the linux pc as follows:<br>[shell_prompt#: scp username@vendordevice_ip_address:/directory_Path_to_logs_xxx/file_name_date_time_sequence* | | | |
| 16 | Test conductor will verify that all files transferred using scp protocol are transferred without any errors | | | |
| 17 | Test Conductor will attempt remote file transfers from the vendor device to the Lee Mixon scp server with IPv6 address of "2001:470:bc55::2" | | | |
| 18 | Test conductor at the shell prompt from the vendor device will use scp to transfer saved/closed files in the CML directory over to the Lee Mixon SCP server | | | |
| 19 | Test conductor will use the following command method for this test:<br>Shell_prompt#: scp cml_log_files_name* vendortest@[2001:470:bc55::2]: | | | |
| 20 | Test conductor will observe file transfer from the vendor device to the Lee Mixon SCP server | | | |
| 21 | Test conductor will access the Lee Mixon SCP server from another pc to verify file transfer was successful and all files were transferred from the vendor device to the scp server | | | |

| | | | | |
|---|---|---|---|---|
| | without any errors | | | |
| 22 | Test conductor will delete all files from the scp server and observe an automatic transfer of files from the vendor device using scp scripts to the Lee Mixon scp server | | | |
| 23 | Test conductor will halt vendor system and issue a run command to see if closed CML files as result of “halt” / “run” commands have been transferred automatically to the Lee Mixon SCP server | | | |
| 24 | Test conductor will halt vendor system and issue a run command to see if closed CML files as result of “halt” / “run” commands have been transferred automatically to the Lee Mixon SCP server | | | |
| 25 | Vendor may provide the test conductor with instructions to change the transfer time schedule so it can push files on 5 minute intervals for this test | | | |
| 26 | If vendor changes time interval to 5 minutes, closed CML log files as the result of the system “halt”/”run” should be uploaded to the remote SCP server | | | |

***Steps to verify requirements in the CM_RLFM test case CML Storage Threshold 1:***

| Steps | Procedure | Expected Result | Actual Result | Comments |
|---|---|---|---|---|
| 1 | Test conductor will open a second terminal window to the vendor device | | | |
| 2 | Test conductor will have two login sessions side-by- | | | |

| | | | | |
|---|---|---|---|---|
| | side on the screen to test purging capability of CML files and storage management | | | |
| 3 | Test conductor will issue a command to write a zero file within the CML logs directory to fill the storage space. The command to write a zero file as follows [shell_prompt#: dd if=/dev/zero of=/directory_Path_to_logs _xxx/file_name_date_time_ sequence.xxx bs=1Mb] | | | |
| 4 | Test conductor will observe on the second screen by continually listing the files within the directory to confirm CML files being purged/expunged from oldest to newly created order. The command to observe directory and storage space as follows, [df –h (storage space)], [ls –ah (list files)] | | | |
| 5 | Test conductor will intentionally disconnect the vendor device from the backend server so there is not route to the Lee Mixon SCP server | | | |
| 6 | Test conductor will confirm when the storage capacity reaches 50%, the vendor device should attempt to upload closed generated system CML files to the remote backend SCP server | | | |
| 7 | System must attempt to upload files on a 3 try interval with 300 seconds / 5 minute before purging oldest closed CML files in order to free up storage space | | | |

## 4.3 Heartbeat Messaging, Immediate Forward/Store & Repeat

The RSE will collect system status and communication interface log files and periodically transfer them to a back office collection service using the available backhaul connection. The RSE will also send Health Monitoring messages to a back office service such that the status of the device can be monitored remotely.

### *4.3.1 Test Case SYSMGNT-HM-GEN*

#### *4.3.1.1 GENERAL TEST DESCRIPTION*

This Test Case evaluates the RSEs ability to send "heartbeat" messages to a back office server.

| | | |
|---|---|---|
| **Test Case #** | **SYSMGNT-HM-GEN** | |
| **Test Case** | **Heartbeat Message Generation and Suspension** | |
| **Reference** | *T-10001-T2-05_RSE_Device_Design_Specification_v30* | |
| **Objective** | Confirm the RSE under evaluation sends a "heartbeat" message to a back office server and suspends transmission of the "heartbeat" message when a fault condition exists. | |
| **Brief Description** | The RSE under evaluation sends a "heartbeat" message, formatted according to Appendix E of RSE Specification v3.0, to a pre-configured IPv6 Address. A (device specific) fault is generated on the RSE to cause the RSE to stop sending the "heartbeat" message. | |
| **Entrance Criteria** | Production grade RSE hardware and software capable of sending and managing the "heartbeat" message is available for evaluation. | |
| **Configuration** | RSE is configured to send a heartbeat message at the default rate to the IPv6 Address of the back office server. | |
| **Primary Requirements** | SRD-USDOTRSE-003-ReqOMC025v001 Heartbeat Transmission | The roadside equipment device shall, when in "Operate" State, transmit a encrypted and signed (Security Profile B.5) IP "heartbeat" message to the configured network address (default to None) of the management entity on a configurable time interval (default to 60 seconds) …. |
| | SRD-USDOTRSE-003-ReqOMC026v001 Heartbeat Transmission Suspension | The roadside equipment device shall suspend transmission of "heartbeat" messages upon detection of an error condition which will significantly impede device operations |
| | SRD-USDOTRSE-003-ReqOMC028v001 Heartbeat Transmission Suspension Log Message | The roadside equipment device shall generate and attempt to log an SSL message upon the suspension of transmission of "heartbeat" messages. |
| **Exit Criteria** | RSE sends a properly formatted "heartbeat" message to the back office server at the default rate and stops sending "heartbeat" messages when a fault condition exists on the RSE. | |
| **Data Outputs** | • Test Conductor Data Sheet and Wireshark captures. | |

*4.3.1.2 EVALUATION PROCEDURES*

After the RSE has been in the "run" mode for a specified amount of time, the Test Conductor will log on to the RSE from a remote server and navigate to the SSL and CML log directories. Test conductor will access the remote MixonHill SCP / System Status server for monitoring of Heartbeat messages from the device under test.

***Steps to verify requirements in the SYSMGNT-HM-GEN test case:***

| Steps | Procedure | Expected Result | Actual Result | Comments |
|---|---|---|---|---|
| 1 | Test conductor will access vendor device over a local Ethernet connection from a PC running Windows/Linux with web browsing capability and ssh client for accessing the RSE/RSU | | | |
| 2 | Test conductor will establish a connection to the vendor RSE/RSU in operation state | | | |
| 3 | Test conductor will navigate to the SSL / CML logs directory per direction in the vendor documentation | | | |
| 4 | Test conductor will issue system commands to list the SSL log files within the SSL logs directory, displayed on the screen | | | |
| 5 | Test conductor will "tail –f" the current active SSL file for latest system status messages. | | | |
| 6 | Test conductor will perform a ping6 from the vendor device to the backend SCP/Heartbeat server setup by Lee Mixon with the IPv6 address of "2001:470:bc55::2" | | | |
| 7 | Test conductor will remote ssh to the Lee Mixon server with the IPv6 address of "2001:470:bc55::2" | | | |
| 8 | Test conductor will | | | |

| | | | | |
|---|---|---|---|---|
| | navigate to the proper vendor directory where the SSL/CML log files along with an active file recording heartbeat messages from the vendor device. | | | |
| 9 | Test conductor will "tail –f" the current active heartbeat message file for latest real time heartbeat status messages from the vendor device. | | | |
| 10 | Test conductor will confirm that a heartbeat message is received from the vendor device once on 60 seconds interval rate in compliance with the heartbeat message format provided in the attachment E of the System Requirements Document. | | | |
| 11 | Test Conductor will ensure that there is sufficient storage space available on the vendor device for the CML log messages to be stored on. | | | |
| 12 | Test Conductor will expect a value of Zero (0) in the heartbeat message file on MixonHill server if the vendor device storage limit is under 65% capacity. | | | |
| 13 | Test Conductor will generate a zero file in the CML log file directory partition to exceed storage limit to above 80% capacity. | | | |
| 14 | Test conductor will verify that no heartbeat messages are being sent as the result of the >80% storage capacity to the LeeMixon heartbeat status file | | | |
| 15 | Test conductor will verify the current active SSL file | | | |

| | | | | |
|---|---|---|---|---|
| | for latest system status messages. Using step five (5) to confirm a system status message was recorded in the active SSL log file. (Heartbeat Transmission Suspended) | | | |
| 16 | Test Conductor will delete the generated zero file in the CML log file directory partition to restore storage capacity below the 80% capacity | | | |
| 17 | Test conductor will verify that heartbeat message transmission is resumed as result of step 16 | | | |
| 18 | Test conductor will verify the current active SSL file for latest system status messages. Using step five (5) to confirm a system status message was recorded in the active SSL log file. (Heartbeat Transmission resumed) | | | |

### *4.3.2 Test Case SYSMGNT-HM-STATCD*

#### *4.3.2.1 GENERAL TEST DESCRIPTION*

This Test Case evaluates the RSEs ability to send the appropriate status code or suspend the transmission of the "heartbeat" messages for given conditions related to Communication Message loge files.

| **Test Case #** | **SYSMGNT-HM-STATCD** |
|---|---|
| **Test Case** | **Heartbeat Message Generation and Suspension** |
| **Reference** | *T-10001-T2-05_RSE_Device_Design_Specification_v30* |
| **Objective** | Confirm the RSE under evaluation includes the correct status code or halts transmission of the "heartbeat" message for a given condition related to Communication Message loge files. |
| **Brief Description** | The RSE under evaluation is connected and sending "heartbeat" messages to a back office server. The RSE is connected and sending Communication Message log files to a different back office server. The connection to the Communication Message log file back end server is abruptly terminated, causing the transfer of Communication Message log files to fail. The "heartbeat" messages will be examined to confirm a status code of 001 is included. |

| | | |
|---|---|---|
| **Test Case #** | **SYSMGNT-HM-STATCD** | |
| **Test Case** | **Heartbeat Message Generation and Suspension** | |
| | With the connection to the Communication Message log file back end server down, the RSE continues to accumulate Communication Message log files. When CML Storage Threshold 2 is reached "heartbeat" messages will be examined to confirm a status code of 002 is included. When CML Storage Threshold 3 is reached it is confirmed that the RSE suspends the transmission of the "heartbeat" messages. | |
| **Entrance Criteria** | Production grade RSE hardware and software capable of sending and managing the "heartbeat" message is available for evaluation. | |
| **Configuration** | RSE is configured to send a heartbeat message at its default rate to the IPv6 Address of the back office server. | |
| **Primary Requirements** | SRD-USDOTRSE-003-ReqCML024v001 CML Automated Off-Load Initiation-Failure | The roadside equipment device shall include a status code (value 001) in the secure Heartbeat Message upon failure to complete the automatic transfer of closed CML files to the configured Remote Management Entity. |
| | SRD-USDOTRSE-003-ReqCML020v001 CML Storage Threshold 2 Processing | The roadside equipment device shall include a status code (value 002) in the secure Heartbeat Message to the configured Management Entity over the Remote IP Connection, using the parameters below, when the cumulative size of CML files reaches a configurable threshold (default to 65% of allocated storage space) hereafter referred to as "CML Storage Threshold 2.<br>• Management Entity Address (…default to "None")<br>• Transmission Count (…default to 3)<br>• Transmission Interval (…default to 15 seconds) |
| | SRD-USDOTRSE-003-ReqCML021v001 CML Storage Threshold 3 Processing | The roadside equipment device shall halt transmission of secure Heartbeat messages over the Remote IP Connection, when the cumulative size of CML files reaches a configurable threshold (default to 80% of allocated storage space) hereafter referred to as "CML Storage Threshold 3. |
| **Exit Criteria** | RSE generates a proper system Status log file entry based on certain conditions related to the Communication Message log files. | |
| **Data Outputs** | • Test Conductor Data Sheet and Wireshark captures. | |

*4.3.2.2 EVALUATION PROCEDURES*

After the RSE has been in the "run" mode for a specified amount of time, the Test Conductor will log on to the RSE from a remote server and navigate to the SSL and CML log directories. Test conductor will access the remote MixonHill SCP / System Status server for monitoring of Heartbeat messages from the device under test.

***Steps to verify requirements in the SYSMGNT-HM-STATCD test case:***

| Steps | Procedure | Expected Result | Actual Result | Comments |
|---|---|---|---|---|
| 1 | Test conductor will access vendor device over a local Ethernet connection from a PC running Windows/Linux with web browsing capability and ssh client for accessing the RSE/RSU | | | |
| 2 | Test conductor will establish a connection to the vendor RSE/RSU in operation state | | | |
| 3 | Test conductor will navigate to the SSL / CML logs directory per direction in the vendor documentation | | | |
| 4 | Test conductor will issue system commands to list the SSL log files within the SSL logs directory, displayed on the screen | | | |
| 5 | Test conductor will "tail –f" the current active SSL file for latest system status messages. | | | |
| 6 | Test conductor will perform a ping6 from the vendor device to the backend SCP/Heartbeat server setup by Lee Mixon with the IPv6 address of "2001:470:bc55::2" | | | |
| 7 | Test conductor will remote ssh to the Lee Mixon server with the IPv6 address of "2001:470:bc55::2" | | | |
| 8 | Test conductor will | | | |

| | | | | |
|---|---|---|---|---|
| | navigate to the proper vendor directory where the SSL/CML log files along with an active file recording heartbeat messages from the vendor device. | | | |
| 9 | Test conductor will "tail –f" the current active heartbeat message file for latest real time heartbeat status messages from the vendor device. | | | |
| 10 | Test Conductor will confirm that a heartbeat message is received from the vendor device once on 60 seconds interval rate in compliance with the heartbeat message format provided in the attachment E of the System Requirements Document. | | | |
| 11 | Test Conductor will disrupt communications between the vendor device and the backhaul CML log file server / "MixonHill SCP server" by changing SCP server IP to an invalid IP address not reachable by the vendor device OR by killing the SCP process running on the vendor device to transfer CML log files to the MixonHill SCP server. | | | |
| 12 | Test conductor will verify that heartbeat messages are being sent as the result of step 11 to the LeeMixon heartbeat status file has changed from value of zero (0) to One (1) | | | |
| 13 | Test Conductor will revert the vendor device configuration for the backhaul SCP to the correct IP address. | | | |

| | | | | |
|---|---|---|---|---|
| 14 | Test conductor will verify that heartbeat messages are being sent as the result of step 13 to the LeeMixon heartbeat status file has changed from value of One (1) to Zero (0) | | | |
| 15 | Test Conductor will ensure that there is sufficient storage space available on the vendor device for the CML log messages to be stored on. | | | |
| 16 | Test Conductor will expect a value of Zero (0) in the heartbeat message file on MixonHill server if the vendor device storage limit is under 65% capacity. | | | |
| 17 | Test Conductor will generate a zero file in the CML log file directory partition to exceed storage limit to above 65% capacity. | | | |
| 18 | Test conductor will verify that heartbeat messages are being sent as the result of the >65% storage capacity to the LeeMixon heartbeat status file has changed from value of zero (0) to Two (2) | | | |
| 19 | Test conductor will verify the current active SSL file for latest system status messages. Using step six (6) to confirm a system status message was recorded in the active SSL log file. (Heartbeat Transmission Suspended) | | | |
| 20 | Test Conductor will generate a zero file in the CML log file directory partition to exceed storage limit to above 80% capacity. | | | |

| | | | | |
|---|---|---|---|---|
| 21 | Test conductor will verify that no heartbeat messages are being sent as the result of the >80% storage capacity to the LeeMixon heartbeat status file | | | |
| 22 | Test conductor will verify the current active SSL file for latest system status messages. Using step six (6) to confirm a system status message was recorded in the active SSL log file. (Heartbeat Transmission Suspended) | | | |
| 23 | Test Conductor will delete the generated zero file in the CML log file directory partition to restore storage capacity below the 80% capacity | | | |
| 24 | Test conductor will verify that heartbeat message transmission is resumed as result of step 17 | | | |
| 25 | Test conductor will verify the current active SSL file for latest system status messages. Using step six (6) to confirm a system status message was recorded in the active SSL log file. (Heartbeat Transmission resumed) | | | |

### 4.4 WSMP Immediate Forward Functionality

The RSE will transmit WAVE Short Message Protocol (WSMP) messages using the Immediate Forward functionality. To support this functionality, messages containing the RSE broadcast instructions and the hex encoded version of the ASN.1 WSMP payload will be received periodically on an interface other than DSRC (e. g. Ethernet connection from a Signal Controller), the RSE will decode the broadcast instructions and transmit the payload per those instructions.

### *4.4.1 Test Case WSMP-IF*

#### *4.4.1.1 GENERAL TEST DESCRIPTION*

This Test Case evaluates the RSEs ability to send WSMP messages according to broadcast instructions and payload received as a text file from an external source.

| | |
|---|---|
| **Test Case #** | **WSMP-IF** |
| **Test Case** | **WAVE Short Message Protocol Immediate Forward** |
| **Reference** | *T-10001-T2-05_RSE_Device_Design_Specification_v30* |
| **Objective** | Confirm the RSE under evaluation sends WSMP messages on the appropriate channel (CCH or SCH) in the appropriate mode (alternating or continuous) according to broadcast instructions and with the correct payload upon receiving a properly formatted text file from an external source through its Local System Interface. |
| **Brief Description** | Two files, formatted according to Appendix D of RSE Specification v3.0 are sent to the Local System Interface of the RSE under evaluation at a rate of 10 times per second (representing a SPaT message) and 1 time per second (representing a Map message) for 20 minutes. The RSE broadcasts the payload of each file as a separate WSMP message according to the broadcast instructions contained within that file. The files, the number of times the files are sent to the RSE, and all transmitted WSMP packets, are captured and recorded. The number of WSMP packets the RSE transmits should equal 99.9% of the number of times the file is sent to the RSE. A sample number of WSMP packets containing both payloads are decoded to confirm the sent payload matches the payload contained in the file sent to the RSE.<br><br>The same two text files will be utilized throughout the evaluation, 1 representing a SPaT message sent 10 times per second and 1 representing a MAP message sent 1 time per second. Each configuration listed below will be evaluated separately.<br><br>After all applicable configurations have been evaluated, the connection to the external source sending the text files to the RSE will be removed abruptly and the system status log file will be examined to confirm an entry was made recording the time of the event. |
| **Entrance Criteria** | Production grade RSE hardware and software capable of the Immediate Forward functionality on the CCH (Optional) and SCH (Mandatory) and in both continuous and alternating modes is available for evaluation. |
| **Configuration 1 (Optional)** | RSE is configured for Alternating Mode. WSMP messages are sent on the default SCH based on files received through a Local System Interface. (Note: WSA should advertise the PSID contained in the received file) |
| **Configuration 2 (Optional)** | RSE is configured for Alternating Mode. WSMP messages are sent on the CCH based on files received through a Local System Interface. |
| **Configuration 3 (Mandatory for Safety** | RSE is configured for Continuous Mode. WSMP messages are sent on SCH 172 based on files received through a Local System Interface. |

| | | | |
|---|---|---|---|
| **Test Case #** | | **WSMP-IF** | |
| **Test Case** | | **WAVE Short Message Protocol Immediate Forward** | |
| **Pilot Model Deployment)** | | | |
| **Primary Requirements** | **Config 1, 2, 3** | SRD-USDOTRSE-003-ReqTCM002v001 Traffic Controller Interface – Receive Message | The roadside equipment device shall accept any message received from a traffic controller (without authentication).<br>(Note: a server will be used as a surrogate "Traffic Controller" for evaluation). |
| | **Config 1, 2, 3** | SRD-USDOTRSE-003-ReqTCM003v001 Traffic Controller Message – Transmit over DSRC | The roadside equipment device shall transmit each message received from a traffic controller over its DSRC radios according to the configured DSRC parameters (bypassing the Active Message List).<br>(Note: a server will be used as a surrogate "Traffic Controller" for evaluation). |
| | **Config 1, 2, 3** | SRD-USDOTRSE-003-ReqTCM004v001 Traffic Controller Connection State | The roadside equipment device shall log a system status log entry identifying and time-stamping a loss in connectivity to the traffic controller as defined by a configurable threshold |
| **Secondary Requirements** | **Config 1, 2, 3** | SRD-USDOTRSE-003-ReqDRS015v001 IEEE 802.11p Regulatory Class 17 | The roadside equipment device shall support Regulatory class 17 (even 10 MHz channels in the range 172 to 184). |
| | **Config 1, 2, 3** | SRD-USDOTRSE-003-ReqDRS045v001 IEEE 1609.3 WSMP Data | The roadside equipment device shall process (both transmit and receive) WAVE Short Message Protocol (WSMP) messages.<br>(Note: only the transmit function will be evaluated in this test). |
| | **Config 1, 2, 3** | SRD-USDOTRSE-003-ReqDRS029v001 IEEE 1609.3 PSID-Specific User Priority | The roadside equipment device shall assign a configurable PSID value (default to the value specified for the associated application area defined in IEEE 1609.12, D0.5) and a configurable User Priority value (default to 2) to each data frame. |
| | **Config 1, 2, 3** | SRD-USDOTRSE-003-ReqDRS033v001 IEEE 1609.4 Radio Operating Mode Support | Each DSRC radio in the roadside equipment device shall be capable of being configured to operate either in "continuous" (single channel) or "alternating" (Channel Switching) modes, as shown in IEEE 1609.4-2010 (Figure 10). |
| | **Config 1, 2** | SRD-USDOTRSE-003-ReqDRS047v001 IEEE 1609.4 | If configured for "alternating" mode, a DSRC radio in the roadside equipment device shall be configurable to send messages either on |

| | | | |
|---|---|---|---|
| **Test Case #** | | **WSMP-IF** | |
| **Test Case** | | **WAVE Short Message Protocol Immediate Forward** | |
| | | Alternating Channel Mode | Channel 178 during the Control Channel (CCH) interval, or on any of the 10 MHz or 20 MHz service channels<br>(Note: only 10MHz Channels will be evaluated in this test). |
| | **Config 1, 2** | SRD-USDOTRSE-003-ReqDRS041v001 Service Channel Interval | If configured for "alternating" mode, a DSRC radio in the roadside equipment device shall be configurable to switch on every SCH interval to the configured SCH with no time interval restrictions. |
| | **Config 1, 2** | SRD-USDOTRSE-003-ReqDRS036v001 DSRC Radios – Default AlternatingChannel Mode | The roadside equipment device shall operate R1A and if present, R2A, R3A and R4A in Alternating Channel Mode (default Control Channel – 178, default Service Channel – 174). |
| | **Config 3** | SRD-USDOTRSE-003-ReqDRS046v001 IEEE 1609.4 Continuous Channel Mode | If configured for "continuous" mode, each DSRC radio in the roadside equipment device shall also be configurable to operate (send and receive messages) on any (default to Channel 172) of the 10 MHz or 20 MHz channels with no time interval restrictions.<br>(Note: only sending on the SCH 172 will be evaluated in this test). |
| **Exit Criteria** | | RSE transmits WSMP messages according to the broadcast instructions and payload sent to the local system interface of RSE for as long as the files are sent. | |
| **Data Outputs** | | • Test Conductor Data Sheet and output of DSRC WSM analyzer | |

*4.4.1.2 EVALUATION PROCEDURES*

The RSE under test is powered on and communicated over UDP protocol by the test conductor to begin transmitting WSMPs per the RSE specifications over a SCH. A DSRC Protocol Analyzer collects and stores all received packets from the RSE on the designated SCH. A number of captured WSMP packets are used to confirm transmission rate and a sample of WSMP received packets will be decoded to confirm format and content.

***Steps to Turn the RSE into the ON Position with proper GPS signal:***

| Steps | Procedure | Expected Result | Actual Result | Comments |
|---|---|---|---|---|
| 1 | Based on specific RSE / RSU vendor documentation, the units | | | |

| | | | | |
|---|---|---|---|---|
| | will be connected to a power source | | | |
| 2 | All proper communication wiring provided by the RSE/RSU vendor will be connected to the devices | | | |
| 3 | Test Conductor will ensure that a GPS active antenna with a clear view of the sky is connected to the RSE/RSU | | | |
| 4 | Ethernet transmit and receive link lights will be verified on the proper designated RSE port and the RSU port. | | | |
| 5 | Per the specification document equipment functionality and operational status will be confirmed via the status LED indicator light on the equipment. | | | |

***Steps to activate the DSRC protocol analyzer:***

| Steps | Procedure | Expected Result | Actual Result | Comments |
|---|---|---|---|---|
| 1 | Boot the portable DSRC protocol analyzer | | | |
| 2 | Open the DSRC protocol analyzer application | | | |
| 3 | Set DSRC protocol analyzer to channel 172 | | | |

***Steps to prepare the Linux Lab server for SPaT/MAP UDP packet forward to vendor device under test:***

| Steps | Procedure | Expected Result | Actual Result | Comments |
|---|---|---|---|---|
| 1 | Test Conductor will access the TOL Linux Server. | | | |
| 2 | Test conductor will use a pre written Shell Bash Script to transmit SPaT/MAP from the Linux server over Ethernet using UDP protocol to the device vendor RSE/RSU | | | |

| | | | | |
|---|---|---|---|---|
| 3 | Test Conductor will use the pre loaded SPaT / MAP files in the same directory as the Bash Script to send files at the correct transmission rate. | | | |
| 4 | Test Conductor will verify that the bash script is set to send SPaT at 10 times a second for 2 to 20 minutes to the vendor device IP address and designated UDP port. | | | |
| 5 | Test Conductor will verify that the bash script is set to send MAP at 1 times a second for 2 to 20 minutes to the vendor device IP address and designated UDP port. | | | |
| 6 | Test Conductor will confirm, SCH is set to 172 in the SPaT test file | | | |
| 7 | Test Conductor will confirm, SCH is set to 172 in the MAP test file | | | |
| 8 | Test Conductor will use a generic Message-Payload for testing purposes in both the SPaT/MAP files | | | |

***Steps to capture data from the RSE/RSU device under test:***

| Steps | Procedure | Expected Result | Actual Result | Comments |
|---|---|---|---|---|
| 1 | Start a capture session on the protocol analyzer on SCH 172 | | | |
| 2 | Test Conductor will observe data being captured by the DSRC packet analyzer during data transmission from the linux server to the Vendor Device under test on the designated system port at the specified time interval of 2 minutes | | | |

| | | | | |
|---|---|---|---|---|
| | by the Bash Script. | | | |
| 3 | Stop the capture session at the end of the transmission and count number of packets received by the packet analyzer | | | |
| 4 | Save the captured data in ".pcap" format in a created specific vendor "name" directory | | | |
| 5 | The captured file name should consist of:<br>- Vendor Name<br>- Test Case<br>- Date | | | |

***Steps to test SPaT file:***

| Steps | Procedure | Expected Result | Actual Result | Comments |
|---|---|---|---|---|
| 1 | Run SPaT Script on the Linux Server. To Execute Test conductor will do the following: ./VendorNameSPAT | | | |
| 2 | The above step should be completed in 5 minutes and should result in data being sent by the vendor device over SCH 172 | | | |

***Steps to test MAP file:***

| Steps | Procedure | Expected Result | Actual Result | Comments |
|---|---|---|---|---|
| 1 | Run MAP Script on the Linux Server. To Execute Test conductor will do the following: ./VendorNameMAP | | | |
| 2 | The above step should be completed in 5 minutes and should result in data being sent by the vendor device over SCH 172 | | | |

***Steps to test SPaT / MAP files simultaneously:***

| Steps | Procedure | Expected Result | Actual Result | Comments |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 1 | Run SPaT / MAP Script on the Linux Server Simultaneously. To Execute Test conductor will do the following: ./VendorNameMAP&&./VendorNameSPAT | | | |
| 2 | The above step should be completed in 5 minutes and should result in data being sent by the vendor device over SCH 172 | | | |

***Steps to Analyze captured data packets SPaT only test:***

Transmit Rate and Packet Data Content

| Steps | Procedure | Expected Result | Actual Result | Comments |
|---|---|---|---|---|
| 1 | Determine number of packets captured during the time interval | 1200 packets | | |
| 2 | Using a calculator divide the number of total packets by the time interval to determine the number of packets transmitted per second | 1200 packets/2 minutes = 10 Hz expected | | |
| 3 | Record the number of packets transmitted per second in the datasheet | | | |
| 4 | Number of packets per second should be compliant with the specifications for default value of 10 Hz | | | |
| 5 | Three random packets will be selected from the captured .pcap file | | | |
| 6 | Packet numbers selected for analysis will be recorded in the datasheet | | | |
| 7 | Each of the three packets will be opened with the DSRC protocol analyzer for detail analysis to confirm the WSMP format / packet content match the PSID / Channel Number / Message | | | |

| | | | | |
|---|---|---|---|---|
| | Payload | | | |
| 8 | Format exceptions will be recorded in the datasheet | | | |

***Steps to Analyze captured data packets MAP only test:***

Transmit Rate and Packet Data Content

| Steps | Procedure | Expected Result | Actual Result | Comments |
|---|---|---|---|---|
| 1 | Determine number of packets captured during the time interval | 120 packets | | |
| 2 | Using a calculator divide the number of total packets by the time interval to determine the number of packets transmitted per second | 120 packets/2 minutes = 1Hz | | |
| 3 | Record the number of packets transmitted per second in the datasheet | | | |
| 4 | Number of packets per second should be compliant with the specifications for default value of 1 Hz | | | |
| 5 | Three random packets will be selected from the captured .pcap file | | | |
| 6 | Packet numbers selected for analysis will be recorded in the datasheet | | | |
| 7 | Each of the three packets will be opened with the DSRC protocol analyzer for detail analysis to confirm the WSMP format / packet content match the PSID / Channel Number / Message Payload | | | |
| 8 | Format exceptions will be recorded in the datasheet | | | |

***Steps to Analyze captured data packets SPaT / MAP simultaneous transmission test:***

Transmit Rate and Packet Data Content

| Steps | Procedure | Expected Result | Actual Result | Comments |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 1 | Determine number of packets captured during the time interval | 3300 packets | | |
| 2 | Using a calculator divide the number of total packets by the time interval to determine the number of packets transmitted per second | | | |
| 3 | Record the number of packets transmitted per second in the datasheet for SPaT / identify by PSID # 0xBFE0 | 3000 packets | | |
| 4 | Record the number of packets transmitted per second in the datasheet for MAP / identify by PSID # 0xBFF0 | 300 packets | | |
| 5 | Number of packets per second should be compliant with the specifications for default value of 10 Hz SPaT only | 10Hz | | |
| 6 | Number of packets per second should be compliant with the specifications for default value of 1 Hz MAP only | 1Hz | | |
| 7 | Three random packets for SPaT and Three random packets for MAP will be selected from the captured .pcap file for S | | | |
| 8 | Packet numbers selected for analysis will be recorded in the datasheet | | | |
| 9 | Each of the three packets will be opened with the DSRC protocol analyzer for detail analysis to confirm the WSMP format / packet content match the PSID / Channel Number / Message Payload | | | |

| | | | | |
|---|---|---|---|---|
| 10 | Format exceptions will be recorded in the datasheet | | | |

## 4.5 WSMP Store and Repeat Functionality

The RSE will transmit WAVE Short Message Protocol (WSMP) messages using the Store and Repeat functionality. To support this functionality, flat files, containing the RSE broadcast instructions and the hex encoded version of the ASN.1 WSMP payload will be loaded on the RSE in a directory specified by the RSE supplier. The RSE will read these files on boot up and "run", decode the broadcast instructions and transmit the payload per those instructions.

### *4.5.1 Test Case WSMP-S&R*

#### *4.5.1.1 GENERAL TEST DESCRIPTION*

This Test Case evaluates the RSEs ability to send WSMP messages according to broadcast instructions and payload contained in text files residing on the device.

| | |
|---|---|
| **Test Case #** | **WSMP-S&R-01** |
| **Test Case** | **WSMP Store and Repeat** |
| **Reference** | *T-10001-T2-05_RSE_Device_Design_Specification_v30* |
| **Objective** | Confirm the RSE under evaluation sends WSMP messages on the appropriate channel (CCH or SCH) in the appropriate mode (alternating or continuous) according to broadcast instructions and with the payload contained in a local file. |
| **Brief Description** | Several files, formatted according to Appendix D of RSE Specification v3.0 are downloaded and stored on the RSE under evaluation. The RSE broadcasts the payload of each file in a separate WSMP message according to the broadcast instructions contained within that file. All messages are broadcast from "DeliveryStart" to "DeliveryStop" and transmitted with a rate of "TxInterval", as specified in their respective file. Broadcast duration and rate will be varied across all messages. The files and all transmitted WSMP packets are captured and recorded. The number of WSMP packets the RSE transmits for each message should equal 99.9% of the transmit rate, "TxInterval", defined in each corresponding file. A sample number of WSMP packets pertaining to each file are decoded to confirm the sent payload matches the payload contained in the corresponding file.<br><br>Each configuration listed below will be evaluated separately. The Active Message List will be replaced, 1 file will be removed from the Active Message List, 1 file will be added to the Active Message List, 1 file on the Active Message List will be modified, and the Active Message List will be reviewed during configuration changes to confirm the proper management of the Active Message List. |
| **Entrance Criteria** | Production grade RSE hardware and software capable of the Store and Repeat functionality on both the CCH and SCH and in both continuous and alternating modes is available for evaluation. |

| | | | |
|---|---|---|---|
| **Test Case #** | | **WSMP-S&R-01** | |
| **Test Case** | | **WSMP Store and Repeat** | |
| **Configuration 1 (optional)** | | RSE is configured for Alternating Mode. 3 messages on the Active Message List are configured to broadcast on the CCH. 3 messages on the Active Message List are configured to broadcast on the default SCH (Note: WSA should advertise the PSIDs contained in the Active Message List).<br>After the completion of Configuration 1, a new Active Message List will be downloaded to the RSE, replacing the existing Active Message List.<br>After the new Active Message List is downloaded, the System Status log file will be examined to confirm an appropriate entry was made. | |
| **Configuration 2 (Optional)** | | RSE is configured for Alternating Mode. All messages on the Active Message List are configured to broadcast on the default SCH (Note: WSA should advertise the PSIDs contained in the Active Message List).<br>After the completion of Configuration 2, 1 file will be removed from the Active Message List and a 1 new file will be added to the Active Message List.<br>After 1 file has been removed and another file added to the Active Message List, the System Status log file will be examined to confirm an appropriate entry was made. | |
| **Configuration 3**<br>**(Mandatory for Safety Pilot Model Deployment)** | | RSE is configured for Alternating Mode. All messages on the Active Message List are configured to broadcast on the CCH.<br>After the completion of Configuration 3, 1 file on the Active Message List will be modified and the Active Message List will be reviewed.<br>After 1 file on the Active Message List is modified, the System Status log file will be examined to confirm an appropriate entry was made. | |
| **Configuration 4 (Optional)** | | RSE is configured for Continuous Mode. All messages on the Active Message List are configured to broadcast on the default SCH (Note: WSA should advertise the PSIDs contained in the Active Message List).<br>After the completion of Configure 4, the Active Message List will be offloaded to an external system.<br>After the Active Message List is offloaded to an external system, the System Status log file will be examined to confirm an appropriate entry was made. | |
| **Primary Requirements** | **Config 1, 2, 3,4** | SRD-USDOTRSE-003-ReqSAR001v001 Information Message Storage | The roadside equipment device shall store up to a configurable number (default of 15, maximum of 100) of SAE J2735 defined messages (hereinafter referred to as an Active Message) along with each message's associated DSRC broadcast parameters …, hereinafter referred to as Message Distribution Instructions) in a cohesive structured list (hereinafter referred to as the Active Message List).<br>(Note: during this evaluation, the Active Message List will contain a maximum of 6 messages) |

| Test Case # | | WSMP-S&R-01 | |
|---|---|---|---|
| **Test Case** | | **WSMP Store and Repeat** | |
| | **Config 1** | SRD-USDOTRSE-003-ReqSAR002v001 Active Message List On-Load | The roadside equipment device shall allow, when in Halt state, an authorized entity to download (to the roadside equipment over a non-DSRC communication interface) a correctly-structured Active Message List replacing the current Active Message List. |
| | **Config 4** | SRD-USDOTRSE-003-ReqSAR003v001 Active Message List Off-load | The roadside equipment device shall allow, when in Halt state, an authorized entity to offload the current Active Message List from the roadside equipment over a non-DSRC communication interface to an external system |
| | **Config 3** | SRD-USDOTRSE-003-ReqSAR004v001 Active Message List Review | Upon request, the roadside equipment device shall allow, when in Halt state, an authorized entity to review the contents (e.g. message id, message type, message distribution instructions) of the Active Message List. |
| | **Config 2** | SRD-USDOTRSE-003-ReqSAR005v001 Active Message Addition | The roadside equipment device shall allow, when in Halt state, an authorized entity to add an Active Message into the Active Message List, provided the Active Message List has an “empty” Slot |
| | **Config 3** | SRD-USDOTRSE-003-ReqSAR006v001 Active Message Modification | The roadside equipment device shall allow, when in Halt state, an authorized entity to modify an Active Message stored in the Active Message List. |
| | **Config 2** | SRD-USDOTRSE-003-ReqSAR007v001 Active Message Deletion | The roadside equipment device shall allow, when in Halt state, an authorized entity to delete an Active Message from the Active Message List. |
| | **Config 1, 2, 3,4** | SRD-USDOTRSE-003-ReqSAR009v001 Active Message Transmission | The roadside equipment device shall transmit each Active Message in the Active Message List according to the associated Message Distribution Instructions |
| | **Config 1, 2, 3, 4** | SRD-USDOTRSE-003-ReqSAR010v001 Active Message Expunge | The roadside equipment device shall remove an Active Message from the Active Message List according to its respective MessageDeliveryStop (“DeliveryStop”) field value in the associated Message Distribution Instructions. |
| | **Config 1, 2, 3, 4** | SRD-USDOTRSE-003-ReqSAR008v001 Active Message List - User Operation Logging | The roadside equipment device shall log a system status log message for each authorized user operation (e.g. upload, download, addition, modification or deletion) attempted on the Active Message List. |

| | | | |
|---|---|---|---|
| **Test Case #** | | **WSMP-S&R-01** | |
| **Test Case** | | **WSMP Store and Repeat** | |
| | **Config 1, 2, 3, 4** | SRD-USDOTRSE-003-ReqSAR015v001 Active Message List – Operation Logging | The roadside equipment device shall log a System Status Log Message containing the results (success, qualified failure) of each system initiated operation (e.g. start transmission, stop transmission, expunge), attempted on the Active Message List |
| **Secondary Requirements verified** | | SRD-USDOTRSE-003-ReqDRS015v001 IEEE 802.11p Regulatory Class 17 | The roadside equipment device shall support Regulatory class 17 (even 10 MHz channels in the range 172 to 184). |
| | | SRD-USDOTRSE-003-ReqDRS045v001 IEEE 1609.3 WSMP Data | The roadside equipment device shall process (both transmit and receive) WAVE Short Message Protocol (WSMP) messages.<br>(Note: only the transmit function is evaluated in this test). |
| | | SRD-USDOTRSE-003-ReqDRS029v001 IEEE 1609.3 PSID-Specific User Priority | The roadside equipment device shall assign a configurable PSID value (default to the value specified for the associated application area defined in IEEE 1609.12, D0.5) and a configurable User Priority value (default to 2) to each data frame. |
| | | SRD-USDOTRSE-003-ReqDRS033v001 IEEE 1609.4 Radio Operating Mode Support | Each DSRC radio in the roadside equipment device shall be capable of being configured to operate either in "continuous" (single channel) or "alternating" (Channel Switching) modes, as shown in IEEE 1609.4-2010 (Figure 10). |
| | | SRD-USDOTRSE-003-ReqDRS047v001 IEEE 1609.4 Alternating Channel Mode | If configured for “alternating” mode, a DSRC radio in the roadside equipment device shall be configurable to send messages either on Channel 178 during the Control Channel (CCH) interval, or on any of the 10 MHz or 20 MHz service channels<br>(Note: only the 10MHz Channels will be evaluated) |
| | | SRD-USDOTRSE-003-ReqDRS041v001 Service Channel Interval | If configured for “alternating” mode, a DSRC radio in the roadside equipment device shall be configurable to switch on every SCH interval to the configured SCH with no time interval restrictions. |
| | | SRD-USDOTRSE-003-ReqDRS036v001 DSRC Radios – Default AlternatingChannel Mode | The roadside equipment device shall operate R1A and if present, R2A, R3A and R4A in Alternating Channel Mode (default Control Channel – 178, default Service Channel – 174). |

| Test Case # | **WSMP-S&R-01** |
|---|---|
| **Test Case** | **WSMP Store and Repeat** |
| **Exit Criteria** | RSE transmits WSMP messages according to the broadcast instructions, and includes the payload, contained in files stored locally on the RSE. |
| **Data Outputs** | • Test Conductor Data Sheet and output of DSRC WSM analyzer |

*4.5.1.2 EVALUATION PROCEDURES*

DESCRIPTION

The RSE under test is powered on and communicated over an Ethernet connection by the test conductor to transfer TIM messages on to the vendor device. A DSRC Protocol Analyzer collects and stores all received packets from the RSE on the designated CCH. A number of captured WSMP packets are used to confirm transmission rate and a sample of WSMP received packets will be decoded to confirm format and content.

Device successfully processed the three TIM messages in the Active Message Log directory

***Steps to Turn the RSE into the ON Position with proper GPS signal:***

| Steps | Procedure | Expected Result | Actual Result | Comments |
|---|---|---|---|---|
| 1 | Based on specific RSE / RSU vendor documentation, the units will be connected to a power source | | | |
| 2 | All proper communication wiring provided by the RSE/RSU vendor will be connected to the devices | | | |
| 3 | Test Conductor will ensure that a GPS active antenna with a clear view of the sky is connected to the RSE/RSU | | | |
| 4 | Ethernet transmit and receive link lights will be verified on the proper designated RSE port and the RSU port. | | | |
| 5 | Per the specification document equipment functionality and operational status will be confirmed via the status LED indicator light on the | | | |

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|---|---|---|---|---|
| | equipment. | | | |

***Steps to activate the DSRC protocol analyzer:***

| Steps | Procedure | Expected Result | Actual Result | Comments |
|---|---|---|---|---|
| 1 | Boot the portable DSRC protocol analyzer | | | |
| 2 | Open the DSRC protocol analyzer application | | | |
| 3 | Set DSRC protocol analyzer to channel 178 | | | |

***Steps to prepare the Linux Lab server for communications with the vendor device under test and transfer active TIM files:***

| Steps | Procedure | Expected Result | Actual Result | Comments |
|---|---|---|---|---|
| 1 | Test Conductor will access the TOL Linux Server. | | | |
| 2 | Test conductor will use three (3) prepared TIM_R1.txt, TIM_R2, and TIM_R3 files for testing | | | |
| 3 | Test Conductor will confirm, Transmit Channel is set to 178 in all three of the TIM test files with proper PSID of 0x8003 | | | |
| 4 | Test Conductor will use a generic Message-Payload for testing purposes in all three files with a minor distinct bit changes to distinguish them apart for analysis | | | |
| 5 | Test Conductor will copy the three files to the vendor device over the network into a /tmp directory for later use in this test | | | |

***Steps to capture data from the RSE/RSU device under test :***

| Steps | Procedure | Expected Result | Actual Result | Comments |
|---|---|---|---|---|
| 1 | Start a capture session on | | | |

| | | | | |
|---|---|---|---|---|
| | the protocol analyzer on CCH 178 | | | |
| 2 | Test Conductor will observe data being captured by the DSRC packet analyzer during data transmission from the Vendor Device under test when system is activated to process active TIM messages | | | |
| 3 | Stop the capture session at the end of the transmission and count number of packets received by the packet analyzer | | | |
| 4 | Save the captured data in ".pcap" format in a created specific vendor "name" directory | | | |
| 5 | The captured file name should consist of:<br>- Vendor Name<br>- Test Case<br>- Date | | | |

***Steps to set baseline for the TIM transmission Test:***

| Steps | Procedure | Expected Result | Actual Result | Comments |
|---|---|---|---|---|
| 1 | Test Conductor will access vendor device from the TOL lab linux server using SSH. | | | |
| 2 | Test Conductor will ensure there are no active TIM messages on the vendor device. | | | |
| 3 | Test Conductor will observe on the DSRC protocol analyzer and ensure that no WSMP / TIM messages are being broadcasted by the vendor device on CCH 178. | | | |
| 4 | Test Conductor will confirm that WSAs/SWASs are only being broadcasted | | | |

| | | | | |
|---|---|---|---|---|
| | from the vendor device on CCH 178 at this point | | | |
| 5 | Test Conductor will perform a “system app halt” on vendor device | | | |
| 6 | Test Conductor will confirm by observing DSRC protocol analyzer that WSAs/SWASs stopped broadcasted from the vendor device on CCH 178 | | | |
| 7 | Test Conductor will copy TIM_R1.txt from the /tmp directory over to the designated TIM active directory. TIM_R1 will be modified with a TimeDeliveryStart and End to reflect current date and 24 hours time. | | | |
| 8 | Test Conductor will perform a “system app run” on vendor device. | | | |
| 9 | Test Conductor should see that WSAs/SWASs and WSMPs are being broadcasted from the vendor device on CCH 178 at this point | | | |
| 10 | Test conductor should observe WSMP packets being broadcasted at the rate of one (1) per second on CCH 178 separate from the WSA packets | | | |
| 11 | Test Conductor will open one of the WSMP packets for analysis to ensure correct PSID and payload is contained within the packet | | | |
| 12 | Test Conductor will perform a “system app halt” on vendor device to halt the system | | | |
| 13 | Test Conductor will verify system was halted by | | | |

| | | | | |
|---|---|---|---|---|
| | observing DSRC protocol analyzer not getting any over the air traffic from the vendor device. | | | |

***Steps to test all three TIM messages simultaneously Test:***

| Steps | Procedure | Expected Result | Actual Result | Comments |
|---|---|---|---|---|
| 1 | Test Conductor will access vendor device from the TOL lab linux server using SSH. | | | |
| 2 | Test Conductor will ensure there are no active TIM messages on the vendor device. | | | |
| 3 | Test Conductor will observe on the DSRC protocol analyzer and ensure that no WSMP / TIM messages are being broadcasted by the vendor device on CCH 178. | | | |
| 4 | Test Conductor will confirm that WSAs/SWASs are only being broadcasted from the vendor device on CCH 178 at this point | | | |
| 5 | Test Conductor will perform a “system app halt” on vendor device | | | |
| 6 | Test Conductor will confirm by observing DSRC protocol analyzer that WSAs/SWASs stopped broadcasted from the vendor device on CCH 178 | | | |
| 7 | Test Conductor will copy TIM_R1.txt , TIM_R2 and TIM_R3 from the /tmp directory over to the designated TIM active directory. TIM files will be modified with a TimeDeliveryStart and End to reflect a start / stop order | | | |

| | | | | |
|---|---|---|---|---|
| 8 | Test Conductor will issue a "date" command at the prompt to note current system date and time (UTC time zone) Example: Tue May 1 15:55:01 UTC 2012 | | | |
| 9 | Test conductor will modify TIM files with start and stop times of 5 minutes intervals with each file overlapping the other by 1 minute. ****We are using time in step 8 as an example for this script but during testing current system time will be used for this test**** | | | |
| 10 | Test Conductor will modify TIM_R1.txt with the following time interval and save file to current directory.<br>DeliveryStart=05/01/2012, 16:05<br>DeliveryStop= 05/01/2012, 16:10 | | | |
| 11 | Test Conductor will modify TIM_R2.txt with the following time interval and save file to current directory.<br>DeliveryStart=05/01/2012, 16:06<br>DeliveryStop= 05/01/2012, 16:11 | | | |
| 12 | Test Conductor will modify TIM_R3.txt with the following time interval and save file to current directory.<br>DeliveryStart=05/01/2012, 16:07<br>DeliveryStop= 05/01/2012, 16:12 | | | |
| 13 | Test Conductor will | | | |

| | | | | |
|---|---|---|---|---|
| | perform a “system app run” on vendor device. | | | |
| 14 | Test Conductor should see that WSAs/SWASs are only being broadcasted from the vendor device on CCH 178 at this point | | | |
| 15 | Test Conductor will continue to observe the DSRC protocol analyzer and keep time, when the time reaches ( (05/01/2012, 16:05)) test conductor should see the first WSMP packet broadcast at 1 times per second reflecting TIM_R1.txt. It should continue to broadcast at that rate until stop time which was set to ((05/01/2012, 16:10)) in TIM_R1.txt. | | | |
| 16 | Test Conductor will continue to observe the DSRC protocol analyzer and keep time, when the time reaches ( (05/01/2012, 16:06)) test conductor should see the second WSMP packet broadcast at 1 times per second reflecting TIM_R2.txt. It should continue to broadcast at that rate until stop time which was set to ((05/01/2012, 16:11)) in TIM_R2.txt. | | | |
| 17 | Test Conductor will continue to observe the DSRC protocol analyzer and keep time, when the time reaches ( (05/01/2012, 16:07)) test conductor should see the third WSMP packet broadcast at 1 times per second reflecting TIM_R3.txt. It should | | | |

| | | | | |
|---|---|---|---|---|
| | continue to broadcast at that rate until stop time which was set to ((05/01/2012, 16:12)) in TIM_R3.txt. | | | |
| 18 | Test conductor should observe WSMP packets being broadcasted at the rate of one (1) per second on CCH 178 separate from the WSA packets | | | |
| 19 | Test Conductor should observe WSMP packets stopped broadcasting when the appropriate stop time reaches for each active TIM message file with the final time stop of ((05/01/2012, 16:12)) in TIM_R3.txt.<br>At 16:13 there should only be WSAs no WSMPs being broadcasting from the vendor device. | | | |
| 20 | Test Conductor will open one WSMP packet from each TIM file for analysis to ensure correct PSID and payload is contained within the packets | | | |
| 21 | Test Conductor will perform a "system app halt" on vendor device to halt the system | | | |
| 22 | Test Conductor will verify system was halted by observing DSRC protocol analyzer not getting any over the air traffic from the vendor device. | | | |

***Steps to Analyze captured data packets For TIM1, 2 and 3 test:***

Transmit Rate and Packet Data Content

| Steps | Procedure | Expected Result | Actual Result | Comments |
|---|---|---|---|---|
| 1 | Determine number of packets captured during the | | | |

| | | | | |
|---|---|---|---|---|
| | time interval | | | |
| 2 | Using a calculator divide the number of total packets by the time interval to determine the number of packets transmitted per second | | | |
| 3 | Record the number of packets transmitted per second in the datasheet | | | |
| 4 | Number of packets per second should be compliant with the specifications for default value of 1 Hz | | | |
| 5 | Three random packets will be selected from the captured .pcap file<br>One from each TIM file | | | |
| 6 | Packet numbers selected for analysis will be recorded in the datasheet | | | |
| 7 | Each one of the packets will be opened with the DSRC protocol analyzer for detail analysis to confirm the WSMP format / packet content match the PSID / Channel Number / Message Payload | | | |
| 8 | Format exceptions will be recorded in the datasheet | | | |

## 4.6 RSE Multiple Radio Sets

To overcome line-of-sight problems at a given RSE installation location, up to 4 radio sets may be installed providing DSRC communications to all vehicles approaching or departing the location in all required directions.

### *4.6.1 Test Case M-RS Ops-WSA*

This Test Case evaluates the RSEs ability to broadcast WSAs on the Control Channel of all active DSRC Radio-Sets.

| | |
|---|---|
| **Test Case #** | **M-RS WSA Ops** |
| **Test Case** | **Multiple DSRC Radio-Set WAVE Service Advertisement Operation** |

| | | | |
|---|---|---|---|
| **Test Case #** | | **M-RS WSA Ops** | |
| **Test Case** | | **Multiple DSRC Radio-Set WAVE Service Advertisement Operation** | |
| **Reference** | | *T-10001-T2-05_RSE_Device_Design_Specification_v30* | |
| **Objective** | | Confirm the RSE under evaluation broadcasts WSAs on the Control Channel of all active DSRC Radio-Sets. | |
| **Brief Description** | | The RSE under evaluation has additional active DSRC Radio-Sets connected to the main control unit. 1 Radio in each set is configured for "Alternating" mode and the other radio in each set is configured for "Continuous" mode. WSAs are broadcast 10 times per second for 5 minutes on the Control Channel of all active DSRC Radio-Sets. All transmitted WSA packets are captured and recorded. The number of WSA packets the RSE transmits should equal 99.9% of the calculated packet count based on the duration of transmission multiplied by the number of active Radio-Sets connected to the RSE (e. g. if the RSE has 2 active Radio-Sets and broadcast WSAs at 10 times a second for 5 minutes, the RSE should transmit ((10\sec*300 sec)*2 radios)*0.999, or 5994 packets). | |
| **Entrance Criteria** | | • Production grade RSE hardware and software capable of supporting multiple DSRC Radio-Sets is available for evaluation.<br>• Multiple DSRC Radio-Sets for the RSE under evaluation are available.<br>• RSE under evaluation has successfully passed Test Case IP-SWSA-01 | |
| **Configuration 1 (Mandatory)** | | 1 additional DSRC Radio-Set is connected to the main control unit, for a total of 2 DSRC Radio-Sets | |
| **Configuration 2 (Optional)** | | 2 additional DSRC Radio-Set is connected to the main control unit, for a total of 3 DSRC Radio-Sets | |
| **Configuration 3 (Optional)** | | 3 additional DSRC Radio-Set is connected to the main control unit, for a total of 4 DSRC Radio-Sets | |
| **Primary Requirements** | **Config 1, 2, 3** | SRD-USDOTRSE-003-ReqDRS002v001 Maximum Number of DSRC Radio Sets | The roadside equipment device shall operationally support a maximum of four (4) 5.9 GHz DSRC Radio Sets (R2, R3 & R4).<br><br>**Note**: On a site basis, up to three external DSRC Radio Sets will be connected to the roadside equipment chassis. |
| | **Config 1, 2, 3** | SRD-USDOTRSE-003-ReqMSG003v001 WAVE Message Transmission | The roadside equipment device shall transmit an outbound WAVE message to each active DSRC radio which is configured to support the targeted transmit channel of the message.<br><br>**Note:** For example, a WAVE configured for transmission over the control channel will be sent to each radio configured for "Alternating Mode" |

| | | | |
|---|---|---|---|
| **Test Case #** | | **M-RS WSA Ops** | |
| **Test Case** | | **Multiple DSRC Radio-Set WAVE Service Advertisement Operation** | |
| **Secondary Requirements** | **Config 1, 2, 3** | SRD-USDOTRSE-003-ReqDRS015v001 IEEE 802.11p Regulatory Class 17 | The roadside equipment device shall support Regulatory class 17 (even 10 MHz channels in the range 172 to 184). |
| | **Config 1** | SRD-USDOTRSE-003-ReqDRS045v001 IEEE 1609.3 WSMP Data | The roadside equipment device shall process (both transmit and receive) WAVE Short Message Protocol (WSMP) messages.<br>(Note: only the transmit function will be evaluated in this test). |
| | **Config 1** | SRD-USDOTRSE-003-ReqDRS029v001 IEEE 1609.3 PSID-Specific User Priority | The roadside equipment device shall assign a configurable PSID value (default to the value specified for the associated application area defined in IEEE 1609.12, D0.5) and a configurable User Priority value (default to 2) to each data frame. |
| | **Config 1** | SRD-USDOTRSE-003-ReqDRS033v001 IEEE 1609.4 Radio Operating Mode Support | Each DSRC radio in the roadside equipment device shall be capable of being configured to operate either in "continuous" (single channel) or "alternating" (Channel Switching) modes, as shown in IEEE 1609.4-2010 (Figure 10). |
| | **Config 1** | SRD-USDOTRSE-003-ReqDRS047v001 IEEE 1609.4 Alternating Channel Mode | If configured for “alternating” mode, a DSRC radio in the roadside equipment device shall be configurable to send messages either on Channel 178 during the Control Channel (CCH) interval, or on any of the 10 MHz or 20 MHz service channels<br>(Note: only 10MHz Channels will be evaluated in this test). |
| | **Config 1** | SRD-USDOTRSE-003-ReqDRS041v001 Service Channel Interval | If configured for “alternating” mode, a DSRC radio in the roadside equipment device shall be configurable to switch on every SCH interval to the configured SCH with no time interval restrictions. |
| | **Config 1** | SRD-USDOTRSE-003-ReqDRS036v001 DSRC Radios – Default AlternatingChannel Mode | The roadside equipment device shall operate R1A and if present, R2A, R3A and R4A in Alternating Channel Mode (default Control Channel – 178, default Service Channel – 174). |
| | **Config 1** | SRD-USDOTRSE-003-ReqDRS046v001 IEEE 1609.4 | If configured for “continuous” mode, each DSRC radio in the roadside equipment device shall also be configurable to operate (send and |

| | | |
|---|---|---|
| **Test Case #** | **M-RS WSA Ops** | |
| **Test Case** | **Multiple DSRC Radio-Set WAVE Service Advertisement Operation** | |
| | Continuous Channel Mode | receive messages) on any (default to Channel 172) of the 10 MHz or 20 MHz channels with no time interval restrictions.<br>(Note: only 1 SCH will be evaluated in this test). |
| **Exit Criteria** | RSE transmits WSAs on the Control Channel of all active Radio-Sets at the defined rate. | |
| **Data Outputs** | • Test Conductor Data Sheet and output of DSRC Protocol Analyzer | |

*4.6.1.1 EVALUATION PROCEDURES*

Test conductor will make use of two radio sets for this test case. The RSEs under test are powered on and begins transmitting WSAs per the RSE specification. A DSRC Protocol Analyzer collects and stores all received packets from the RSEs. The numbers of captured WSAs are used to confirm transmission rate and a sample of WSAs will be reviewed to confirm format and content.

***Steps to Turn the RSE into the ON Position with proper GPS signal:***

| Steps | Procedure | Expected Result | Actual Result | Comments |
|---|---|---|---|---|
| 1 | Based on specific RSE / RSU vendor documentation, the units will be connected to a power source | | | |
| 2 | All proper communication wiring provided by the RSE/RSU vendor will be connected to the devices | | | |
| 3 | Test Conductor will ensure that a GPS active antenna with a clear view of the sky is connected to the RSE/RSUs | | | |
| 4 | Ethernet transmit and receive link lights will be verified on the proper designated RSE ports and the RSU ports. | | | |
| 5 | Per the specification document equipment functionality and operational status will be confirmed via the status | | | |

| | | | | |
|---|---|---|---|---|
| | LED indicator light on the equipment. | | | |

***Steps to activate the DSRC protocol analyzer :***

| Steps | Procedure | Expected Result | Actual Result | Comments |
|---|---|---|---|---|
| 1 | Boot the portable DSRC protocol analyzer | | | |
| 2 | Open the DSRC protocol analyzer application | | | |
| 3 | Set DSRC protocol analyzer to channel 178 | | | |

***Steps to capture data from the RSE/RSU device under test :***

| Steps | Procedure | Expected Result | Actual Result | Comments |
|---|---|---|---|---|
| 4 | Start a capture session on the protocol analyzer | | | |
| 5 | Capture data for at the minimum time interval of 5 minutes | | | |
| 6 | Stop the capture session at the end of the 5 minutes time interval | | | |
| 7 | Save the captured data in ".pcap" format in a created specific vendor "name" directory | | | |
| 8 | The captured file name should consist of:<br>- Vendor Name<br>- Test Case<br>- Date<br>-Time | | | |

***Steps to Analyze captured data packets :***

Transmit Rate

| Steps | Procedure | Expected Result | Actual Result | Comments |
|---|---|---|---|---|
| 9 | Determine number of packets captured during the time interval | | | |
| 10 | Using a calculator divide the number of total packets by the time interval to | | | |

| | | | | |
|---|---|---|---|---|
| | determine the number of packets transmitted per second | | | |
| 11 | Record the number of packets transmitted per second in the datasheet | 2 Radios broadcasting at 10 Hz = 20 Hz | | |
| 12 | Number of packets per second should be compliant with the specifications for 10 Hz from multiple radios | | | |

WSA Format Verification

| Steps | Procedure | Expected Result | Actual Result | Comments |
|---|---|---|---|---|
| 13 | Test Conductor will open a number of packets from the capture session and verify WSA format | | | |
| 14 | Test conductor will confirm WSA packets being broadcasted from the two radios are identical with the exception of the source MAC address | | | |

### *4.6.2 Test Case M-RS Ops-SCH*

This Test Case evaluates the RSEs ability to broadcast WSMP messages on the Service Channel of all active DSRC Radio-Set.

| | |
|---|---|
| **Test Case #** | **M-RS SCH Ops** |
| **Test Case** | **Multiple DSRC Radio-Set Service Channel Operation** |
| **Reference** | *T-10001-T2-05_RSE_Device_Design_Specification_v30* |
| **Objective** | Confirm the RSE under evaluation broadcasts WSMP messages on the Service Channel of all active DSRC Radio-Sets |
| **Brief Description** | The RSE under evaluation has additional active DSRC Radio-Sets connected to the main control unit. 1 Radio in each set is configured for "Alternating" mode and the other radio in each set is configured for "Continuous" mode. One file, formatted according to Appendix D of RSE Specification v3.0 and configured for transmission on the SCH, is sent to the Local System Interface of the RSE at a rate of 10 times per second for 5 minutes. The Service Channel of all RSE Radio Set broadcasts the payload of the file as a WSMP message according to the broadcast |

| | | | |
|---|---|---|---|
| **Test Case #** | | **M-RS SCH Ops** | |
| **Test Case** | | **Multiple DSRC Radio-Set Service Channel Operation** | |
| | | instructions contained within the file. The file, the number of times the file is sent to the RSE, and all transmitted WSMP packets, are captured and recorded. The number of WSMP packets the RSE transmits should equal 99.9% of the number of times the file is sent to the RSE multiplied by the number of Radio-Sets connected to the RSE (e. g. if the RSE has 2 active Radio-Sets and the file is sent 500 time, the RSE should transmit (500*2)*0.999, or 999 messages). | |
| **Entrance Criteria** | | • Production grade RSE hardware and software capable of supporting multiple DSRC Radio-Sets is available for evaluation.<br>• Multiple DSRC Radio-Sets for the RSE under evaluation are available.<br>• RSE under evaluation has successfully passed Test Case WSMP-IF | |
| **Configuration 1 (Mandatory)** | | 1 additional DSRC Radio-Set is connected to the main control unit, for a total of 2 DSRC Radio-Sets | |
| **Configuration 2 (Optional)** | | 2 additional DSRC Radio-Set is connected to the main control unit, for a total of 3 DSRC Radio-Sets | |
| **Configuration 3 (Optional)** | | 3 additional DSRC Radio-Set is connected to the main control unit, for a total of 4 DSRC Radio-Sets | |
| **Primary Requirements** | **Config 1, 2, 3** | SRD-USDOTRSE-003-ReqDRS002v001 Maximum Number of DSRC Radio Sets | The roadside equipment device shall operationally support a maximum of four (4) 5.9 GHz DSRC Radio Sets (R2, R3 & R4).<br><br>**Note**: On a site basis, up to three external DSRC Radio Sets will be connected to the roadside equipment chassis. |
| | **Config 1, 2, 3** | SRD-USDOTRSE-003-ReqMSG003v001 WAVE Message Transmission | The roadside equipment device shall transmit an outbound WAVE message to each active DSRC radio which is configured to support the targeted transmit channel of the message.<br><br>**Note:** For example, a WAVE configured for transmission over the control channel will be sent to each radio configured for "Alternating Mode" |
| **Secondary Requirements** | **Config 1, 2, 3** | SRD-USDOTRSE-003-ReqDRS015v001 IEEE 802.11p Regulatory Class 17 | The roadside equipment device shall support Regulatory class 17 (even 10 MHz channels in the range 172 to 184). |
| | **Config 1** | SRD-USDOTRSE-003-ReqDRS045v001 IEEE 1609.3 WSMP Data | The roadside equipment device shall process (both transmit and receive) WAVE Short Message Protocol (WSMP) messages.<br><br>(Note: only the transmit function will be |

| | | | |
|---|---|---|---|
| **Test Case #** | | **M-RS SCH Ops** | |
| **Test Case** | | **Multiple DSRC Radio-Set Service Channel Operation** | |
| | | | evaluated in this test). |
| | **Config 1** | SRD-USDOTRSE-003-ReqDRS029v001 IEEE 1609.3 PSID-Specific User Priority | The roadside equipment device shall assign a configurable PSID value (default to the value specified for the associated application area defined in IEEE 1609.12, D0.5) and a configurable User Priority value (default to 2) to each data frame. |
| | **Config 1** | SRD-USDOTRSE-003-ReqDRS033v001 IEEE 1609.4 Radio Operating Mode Support | Each DSRC radio in the roadside equipment device shall be capable of being configured to operate either in "continuous" (single channel) or "alternating" (Channel Switching) modes, as shown in IEEE 1609.4-2010 (Figure 10). |
| | **Config 1** | SRD-USDOTRSE-003-ReqDRS047v001 IEEE 1609.4 Alternating Channel Mode | If configured for “alternating” mode, a DSRC radio in the roadside equipment device shall be configurable to send messages either on Channel 178 during the Control Channel (CCH) interval, or on any of the 10 MHz or 20 MHz service channels<br>(Note: only 10MHz Channels will be evaluated in this test). |
| | **Config 1** | SRD-USDOTRSE-003-ReqDRS041v001 Service Channel Interval | If configured for “alternating” mode, a DSRC radio in the roadside equipment device shall be configurable to switch on every SCH interval to the configured SCH with no time interval restrictions. |
| | **Config 1** | SRD-USDOTRSE-003-ReqDRS036v001 DSRC Radios – Default AlternatingChannel Mode | The roadside equipment device shall operate R1A and if present, R2A, R3A and R4A in Alternating Channel Mode (default Control Channel – 178, default Service Channel – 174). |
| | **Config 1** | SRD-USDOTRSE-003-ReqDRS046v001 IEEE 1609.4 Continuous Channel Mode | If configured for “continuous” mode, each DSRC radio in the roadside equipment device shall also be configurable to operate (send and receive messages) on any (default to Channel 172) of the 10 MHz or 20 MHz channels with no time interval restrictions.<br>(Note: only 1 SCH will be evaluated in this test). |
| **Exit Criteria** | | RSE transmits WSMP messages on the Service Channel of all active Radio-Sets according to the broadcast instructions and payload sent to the | |

| | |
|---|---|
| **Test Case #** | **M-RS SCH Ops** |
| **Test Case** | **Multiple DSRC Radio-Set Service Channel Operation** |
| | local system interface of RSE for as long as the files are sent. |
| **Data Outputs** | • Test Conductor Data Sheet and output of DSRC Protocol Analyzer |

*4.6.2.1 EVALUATION PROCEDURES*

The RSEs under test is powered on and communicated over UDP protocol by the test conductor to begin transmitting WSMPs per the RSE specifications over a SCH. A DSRC Protocol Analyzer collects and stores all received packets from the RSE on the designated SCH. A number of captured WSMP packets are used to confirm transmission rate and a sample of WSMP received packets will be reviewed to confirm format and content from multiple radio sets.

***Steps to Turn the RSE into the ON Position with proper GPS signal:***

| Steps | Procedure | Expected Result | Actual Result | Comments |
|---|---|---|---|---|
| 1 | Based on specific RSE / RSU vendor documentation, the units will be connected to a power source | | | |
| 2 | All proper communication wiring provided by the RSE/RSU vendor will be connected to the devices | | | |
| 3 | Test Conductor will ensure that a GPS active antenna with a clear view of the sky is connected to the RSE/RSU | | | |
| 4 | Ethernet transmit and receive link lights will be verified on the proper designated RSE ports and the RSU ports. | | | |
| 5 | Per the specification document equipment functionality and operational status will be confirmed via the status LED indicator light on the equipment. | | | |

***Steps to activate the DSRC protocol analyzer:***

| Steps | Procedure | Expected Result | Actual Result | Comments |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 1 | Boot the portable DSRC protocol analyzer | | | |
| 2 | Open the DSRC protocol analyzer application | | | |
| 3 | Set DSRC protocol analyzer to channel 172 | | | |

***Steps to prepare the Linux Lab server for SPaT/MAP UDP packet forward to vendor device under test:***

| Steps | Procedure | Expected Result | Actual Result | Comments |
|---|---|---|---|---|
| 1 | Test Conductor will access the TOL lab Linux Server. | | | |
| 2 | Test conductor will use a pre written Shell Bash Script to transmit SPaT/MAT from the Linux server over Ethernet using UDP protocol to the device vendor RSE/RSU | | | |
| 3 | Test Conductor will use the pre loaded SPaT / MAP files in the same directory as the Bash Script to send files at the correct transmission rate. | | | |
| 4 | Test Conductor will verify that the bash script is set to send SPaT at 10 times a second for 5 minutes to the vendor device IP address and designated UDP port. | | | |
| 5 | Test Conductor will verify that the bash script is set to send MAP at 1 times a second for 5 minutes to the vendor device IP address and designated UDP port. | | | |
| 6 | Test Conductor will confirm, SCH is set to 172 in the SPaT test file | | | |
| 7 | Test Conductor will confirm, SCH is set to 172 in the MAP test file | | | |
| 8 | Test Conductor will use a generic Message-Payload for testing purposes in both | | | |

| | | | | |
|---|---|---|---|---|
| | the SPaT/MAP files | | | |

***Steps to capture data from the RSE/RSU device under test:***

| Steps | Procedure | Expected Result | Actual Result | Comments |
|---|---|---|---|---|
| 1 | Start a capture session on the protocol analyzer on SCH 172 | | | |
| 2 | Test Conductor will observe data being captured by the DSRC packet analyzer during data transmission from the linux server to the Vendor Device under test on the designated system port at the specified time interval of 5 minutes by the Bash Script. | | | |
| 3 | Stop the capture session at the end of the transmission and count number of packets received by the packet analyzer | | | |
| 7 | Save the captured data in ".pcap" format in a created specific vendor "name" directory | | | |
| 8 | The captured file name should consist of:<br>- Vendor Name<br>- Test Case<br>- Date | | | |

***Steps to test SPaT file:***

| Steps | Procedure | Expected Result | Actual Result | Comments |
|---|---|---|---|---|
| 1 | Run SPaT Script on the Linux Server. To Execute Test conductor will do the following: ./VendorNameSPAT | | | |
| 2 | The above step should be completed in 5 minutes and should result in data being sent by the vendor devices over SCH 172 | | | |

***Steps to test MAP file:***

| Steps | Procedure | Expected Result | Actual Result | Comments |
|---|---|---|---|---|
| 1 | Run SPaT Script on the Linux Server. To Execute Test conductor will do the following: ./VendorNameMAP | | | |
| 2 | The above step should be completed in 5 minutes and should result in data being sent by the vendor devices over SCH 172 | | | |

***Steps to test SPaT / MAP files simultaneously:***

| Steps | Procedure | Expected Result | Actual Result | Comments |
|---|---|---|---|---|
| 1 | Run SPaT / MAP Script on the Linux Server Simultaneously. To Execute Test conductor will do the following: ./VendorNameMAP&&./VendorNameSPAT | | | |
| 2 | The above step should be completed in 5 minutes and should result in data being sent by the vendor devices over SCH 172 | | | |

***Steps to Analyze captured data packets SPaT only test:***

Transmit Rate and Packet Data Content

| Steps | Procedure | Expected Result | Actual Result | Comments |
|---|---|---|---|---|
| 1 | Determine number of packets captured during the time interval | 6000 | | |
| 2 | Using a calculator divide the number of total packets by the time interval to determine the number of packets transmitted per second | 6000/300<br>20Hz/2<br>10Hz | | |
| 3 | Record the number of packets transmitted per second in the datasheet | 10Hz | | |

| | | | | |
|---|---|---|---|---|
| 4 | Number of packets per second should be compliant with the specifications for default value of 10 Hz | | | |
| 5 | Random packets will be opened from the captured .pcap file for review with the DSRC protocol analyzer for detail analysis to confirm the WSMP format / packet content match the PSID / Channel Number / Message Payload | | | |
| 6 | Test conductor will confirm WSMP packets being broadcasted from the two radios are identical with the exception of the source MAC address | | | |
| 7 | Format exceptions will be recorded in the datasheet | | | |

***Steps to Analyze captured data packets MAP only test:***

Transmit Rate and Packet Data Content

| Steps | Procedure | Expected Result | Actual Result | Comments |
|---|---|---|---|---|
| 1 | Determine number of packets captured during the time interval | 600/300<br>2Hz/2<br>1Hz | | |
| 2 | Using a calculator divide the number of total packets by the time interval to determine the number of packets transmitted per second | 1Hz | | |
| 3 | Record the number of packets transmitted per second in the datasheet | 1Hz | | |
| 4 | Number of packets per second should be compliant with the specifications for default value of 1 Hz | | | |
| 5 | Random packets will be opened from the | | | |

| | | | | |
|---|---|---|---|---|
| | captured .pcap file for review with the DSRC protocol analyzer for detail analysis to confirm the WSMP format / packet content match the PSID / Channel Number / Message Payload | | | |
| 6 | Test conductor will confirm WSMP packets being broadcasted from the two radios are identical with the exception of the source MAC address | | | |
| 7 | Format exceptions will be recorded in the datasheet | | | |

***Steps to Analyze captured data packets SPaT / MAP simultaneous transmission test:***

Transmit Rate and Packet Data Content

| Steps | Procedure | Expected Result | Actual Result | Comments |
|---|---|---|---|---|
| 1 | Determine number of packets captured during the time interval | 6600 | | |
| 2 | Using a calculator divide the number of total packets by the time interval to determine the number of packets transmitted per second | SPaT 6000/300<br>20/2=10HZ<br>MAP 600/300<br>2/2=1Hz | | |
| 3 | Record the number of packets transmitted per second in the datasheet for SPaT / identify by PSID # 0xBFE0 | | | |
| 4 | Record the number of packets transmitted per second in the datasheet for MAP / identify by PSID # 0xBFF0 | | | |
| 5 | Number of packets per second should be compliant with the specifications for default value of 10 Hz SPaT only | | | |

| | | | | |
|---|---|---|---|---|
| 6 | Number of packets per second should be compliant with the specifications for default value of 1 Hz MAP only | | | |
| 7 | A number of random packets for SPaT and MAP will be selected from the captured .pcap file for review | | | |
| 8 | Test conductor will confirm WSMP packets being broadcasted from the two radios are identical with the exception of the source MAC address | | | |
| 9 | Format exceptions will be recorded in the datasheet | | | |

### *4.6.3 Test Case M-RS Ops-CCH*

This Test Case evaluates the RSEs ability to broadcast WSMP messages on the Control Channel of all active DSRC Radio-Set.

| | |
|---|---|
| **Test Case #** | **M-RS CCH Ops** |
| **Test Case** | **Multiple DSRC Radio-Set Control Channel Operation** |
| **Reference** | *T-10001-T2-05_RSE_Device_Design_Specification_v30* |
| **Objective** | Confirm the RSE under evaluation broadcasts WSMP messages on the Control Channel of all active DSRC Radio-Sets |
| **Brief Description** | The RSE under evaluation has additional active DSRC Radio-Sets connected to the main control unit. 1 Radio in each set is configured for "Alternating" mode and the other radio in each set is configured for "Continuous" mode. One file, formatted according to Appendix D of RSE Specification v3.0 and configured for transmission on the CCH, is sent to the Local System Interface of the RSE at a rate of 10 times per second for 5 minutes. The Control Channel of all active DSRC Radio-Set broadcasts the payload of the file as a WSMP message according to the broadcast instructions contained within the file. The file, the number of times the file is sent to the RSE, and all transmitted WSMP packets, are captured and recorded. The number of WSMP packets the RSE transmits should equal 99.9% of the number of times the file is sent to the RSE multiplied by the number of Radio-Sets connected to the RSE (e. g. if the RSE has 2 active Radio-Sets and the file is sent 500 time, the RSE should transmit (500*2)*0.999, or 999 messages). |
| **Entrance Criteria** | • Production grade RSE hardware and software capable of supporting multiple DSRC Radio-Sets is available for evaluation. |

| | | | |
|---|---|---|---|
| **Test Case #** | | **M-RS CCH Ops** | |
| **Test Case** | | **Multiple DSRC Radio-Set Control Channel Operation** | |
| | | • Multiple DSRC Radio-Sets for the RSE under evaluation are available.<br>• RSE under evaluation has successfully passed Test Case WSMP-IF | |
| **Configuration 1 (Mandatory)** | | 1 additional DSRC Radio-Set is connected to the main control unit, for a total of 2 DSRC Radio-Sets | |
| **Configuration 2 (Optional)** | | 2 additional DSRC Radio-Set is connected to the main control unit, for a total of 3 DSRC Radio-Sets | |
| **Configuration 3 (Optional)** | | 3 additional DSRC Radio-Set is connected to the main control unit, for a total of 4 DSRC Radio-Sets | |
| **Primary Requirements** | **Config 1, 2, 3** | SRD-USDOTRSE-003-ReqDRS002v001 Maximum Number of DSRC Radio Sets | The roadside equipment device shall operationally support a maximum of four (4) 5.9 GHz DSRC Radio Sets (R2, R3 & R4).<br><br>**Note**: On a site basis, up to three external DSRC Radio Sets will be connected to the roadside equipment chassis. |
| | **Config 1, 2, 3** | SRD-USDOTRSE-003-ReqMSG003v001 WAVE Message Transmission | The roadside equipment device shall transmit an outbound WAVE message to each active DSRC radio which is configured to support the targeted transmit channel of the message.<br><br>**Note:** For example, a WAVE configured for transmission over the control channel will be sent to each radio configured for "Alternating Mode" |
| **Secondary Requirements** | **Config 1, 2, 3** | SRD-USDOTRSE-003-ReqDRS015v001 IEEE 802.11p Regulatory Class 17 | The roadside equipment device shall support Regulatory class 17 (even 10 MHz channels in the range 172 to 184). |
| | **Config 1** | SRD-USDOTRSE-003-ReqDRS045v001 IEEE 1609.3 WSMP Data | The roadside equipment device shall process (both transmit and receive) WAVE Short Message Protocol (WSMP) messages.<br><br>(Note: only the transmit function will be evaluated in this test). |
| | **Config 1** | SRD-USDOTRSE-003-ReqDRS029v001 IEEE 1609.3 PSID-Specific User Priority | The roadside equipment device shall assign a configurable PSID value (default to the value specified for the associated application area defined in IEEE 1609.12, D0.5) and a configurable User Priority value (default to 2) to each data frame. |

| | | | |
|---|---|---|---|
| **Test Case #** | | **M-RS CCH Ops** | |
| **Test Case** | | **Multiple DSRC Radio-Set Control Channel Operation** | |
| | **Config 1** | SRD-USDOTRSE-003-ReqDRS033v001 IEEE 1609.4 Radio Operating Mode Support | Each DSRC radio in the roadside equipment device shall be capable of being configured to operate either in "continuous" (single channel) or "alternating" (Channel Switching) modes, as shown in IEEE 1609.4-2010 (Figure 10). |
| | **Config 1** | SRD-USDOTRSE-003-ReqDRS047v001 IEEE 1609.4 Alternating Channel Mode | If configured for "alternating" mode, a DSRC radio in the roadside equipment device shall be configurable to send messages either on Channel 178 during the Control Channel (CCH) interval, or on any of the 10 MHz or 20 MHz service channels<br>(Note: only 10MHz Channels will be evaluated in this test). |
| | **Config 1** | SRD-USDOTRSE-003-ReqDRS041v001 Service Channel Interval | If configured for "alternating" mode, a DSRC radio in the roadside equipment device shall be configurable to switch on every SCH interval to the configured SCH with no time interval restrictions. |
| | **Config 1** | SRD-USDOTRSE-003-ReqDRS036v001 DSRC Radios – Default AlternatingChannel Mode | The roadside equipment device shall operate R1A and if present, R2A, R3A and R4A in Alternating Channel Mode (default Control Channel – 178, default Service Channel – 174). |
| | **Config 1** | SRD-USDOTRSE-003-ReqDRS046v001 IEEE 1609.4 Continuous Channel Mode | If configured for "continuous" mode, each DSRC radio in the roadside equipment device shall also be configurable to operate (send and receive messages) on any (default to Channel 172) of the 10 MHz or 20 MHz channels with no time interval restrictions.<br>(Note: only 1 SCH will be evaluated in this test). |
| **Exit Criteria** | | RSE transmits WSMP messages on the Control Channel of all active DSRC Radio-Sets according to the broadcast instructions and payload sent to the local system interface of RSE for as long as the files are sent. | |
| **Data Outputs** | | • Test Conductor Data Sheet and output of DSRC Protocol Analyzer | |

*4.6.3.1 EVALUATION PROCEDURES*

DESCRIPTION

The RSE under test is powered on and communicated over an Ethernet connection by the test conductor to transfer TIM messages on to the vendor devices. A DSRC Protocol Analyzer collects and stores all

received packets from the RSE on the designated CCH. A number of captured WSMP packets are used to confirm transmission rate and a sample of WSMP received packets will be reviewed to confirm format and content from multiple radio sets.

***Steps to Turn the RSE into the ON Position with proper GPS signal:***

| Steps | Procedure | Expected Result | Actual Result | Comments |
|---|---|---|---|---|
| 1 | Based on specific RSE / RSU vendor documentation, the units will be connected to a power source | | | |
| 2 | All proper communication wiring provided by the RSE/RSU vendor will be connected to the devices | | | |
| 3 | Test Conductor will ensure that a GPS active antenna with a clear view of the sky is connected to the RSE/RSUs | | | |
| 4 | Ethernet transmit and receive link lights will be verified on the proper designated RSE ports and the RSU ports. | | | |
| 5 | Per the specification document equipment functionality and operational status will be confirmed via the status LED indicator light on the equipment. | | | |

***Steps to activate the DSRC protocol analyzer:***

| Steps | Procedure | Expected Result | Actual Result | Comments |
|---|---|---|---|---|
| 1 | Boot the portable DSRC protocol analyzer | | | |
| 2 | Open the DSRC protocol analyzer application | | | |
| 3 | Set DSRC protocol analyzer to channel 178 | | | |

***Steps to prepare the Linux Lab server for communications with the vendor device under test and transfer active TIM files:***

| teps | Procedure | Expected Result | Actual Result | Comments |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 1 | Test Conductor will access the TOL lab Linux Server. | | | |
| 2 | Test conductor will use a prepared TIM_R1.txt file for testing | | | |
| 3 | Test Conductor will confirm, Transmit Channel is set to 178 in all three of the TIM test files with proper PSID of 0x8003 | | | |
| 4 | Test Conductor will use a generic Message-Payload for testing purposes in the TIM file | | | |
| 5 | Test Conductor will copy the file to the vendor device over the network into a /tmp directory for later use in this test | | | |

***Steps to capture data from the RSE/RSU device under test :***

| Steps | Procedure | Expected Result | Actual Result | Comments |
|---|---|---|---|---|
| 1 | Start a capture session on the protocol analyzer on CCH 178 | | | |
| 2 | Test Conductor will observe data being captured by the DSRC packet analyzer during data transmission from the Vendor Device under test when system is activated to process active TIM messages | | | |
| 3 | Stop the capture session at the end of the transmission and count number of packets received by the packet analyzer | | | |
| 4 | Save the captured data in ".pcap" format in a created specific vendor "name" directory | | | |
| 5 | The captured file name | | | |

| | | | | |
|---|---|---|---|---|
| | should consist of:<br>- Vendor Name<br>- Test Case<br>- Date | | | |

***Steps for the TIM transmission Test:***

| Steps | Procedure | Expected Result | Actual Result | Comments |
|---|---|---|---|---|
| 1 | Test Conductor will access vendor device from the TOL lab linux server using SSH. | | | |
| 2 | Test Conductor will ensure there are no active TIM messages on the vendor device. | | | |
| 3 | Test Conductor will observe on the DSRC protocol analyzer and ensure that no WSMP / TIM messages are being broadcasted by the vendor device on CCH 178. | | | |
| 4 | Test Conductor will confirm that WSAs/SWASs are only being broadcasted from the vendor device on CCH 178 at this point | | | |
| 5 | Test Conductor will perform a "system app halt" on vendor device | | | |
| 6 | Test Conductor will confirm by observing DSRC protocol analyzer that WSAs/SWASs stopped broadcasted from the vendor device on CCH 178 | | | |
| 7 | Test Conductor will copy TIM_R1.txt from the /tmp directory over to the designated TIM active directory. TIM_R1 will be modified with a TimeDeliveryStart and End to reflect current date and 24 hours time. Start / End time will be set to 5 | | | |

| | | | | |
|---|---|---|---|---|
| | minutes interval | | | |
| 8 | Test Conductor will perform a “system app run” on vendor device. | | | |
| 9 | Test Conductor should see that WSAs/SWASs are being broadcasted from the vendor devices and WSMPs should begin broadcasting from the vendor device on CCH 178 when the start time set in the TIM_R1 file was set | | | |
| 10 | Test conductor should observe WSMP packets being broadcasted at the rate of one (1) per second on CCH 178 separate from the WSA packets for the 5 minute interval set in the TIM_R1 file | | | |
| 11 | Test Conductor will open several of the WSMP packets for analysis to ensure correct PSID and payload is contained within the packet | | | |
| 12 | Test Conductor will perform a “system app halt” on vendor device to halt the system | | | |
| 13 | Test Conductor will verify system was halted by observing DSRC protocol analyzer not getting any over the air traffic from the vendor device. | | | |

***Steps to Analyze captured data packets For TIM1 test from multiple radios:***

Transmit Rate and Packet Data Content

| Steps | Procedure | Expected Result | Actual Result | Comments |
|---|---|---|---|---|
| 1 | Determine number of packets captured during the 5 minute time interval | | | |

| | | | | |
|---|---|---|---|---|
| 2 | Using a calculator divide the number of total packets by the time interval to determine the number of packets transmitted per second from multiple radio sets | | | |
| 3 | Record the number of packets transmitted per second in the datasheet | | | |
| 4 | Number of packets per second should be compliant with the specifications for default value of 1 Hz | | | |
| 5 | Several random packets will be reviewed from the captured .pcap file one from each radio | | | |
| 7 | Each one of the packets will be opened with the DSRC protocol analyzer for detail analysis to confirm the WSMP format / packet content match the PSID / Channel Number / Message Payload | | | |
| 8 | Format exceptions will be recorded in the datasheet | | | |